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The Forgotten Salmon of the Merrimack

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The Forgotten Salmon of the Merrimack

Lawrence Stolte
Author

Atlantic Salmon
Planner

DEPARTMENT OF THE INTERIOR
NORTHEAST REGION
1981

The frontispiece is courtesy of Hiram Edward Gardner of Concord, New Hampshire. It was taken in 1893 and had the following inscription on its reverse side: 'Here is our day's catch. Aren't they beauties?' The fish are Atlantic salmon and the scene was just east of Sewalls Falls dam-site. The boy wearing the cap is Hiram E. Gardner's older brother, James Frederick Gardner.

Hiram E. Gardner was born in Concord on January 22, 1890 and can still remember the Atlantic salmon of the Merrimack River. According to "Hi," as he is called by his friends, Atlantic salmon were quite numerous, especially in 1893 and 1894. Hi remembers eating salmon on a regular basis in his early childhood, and stated to me that many salmon were salted down in his father's cellar. His father was one of the workmen constructing the Sewalls Falls dam.

The salmon in the picture were not taken by angling but were either netted, clubbed, snagged or speared. Hi indicated that the salmon and shad were so numerous in the spring that these methods were highly productive. He does remember hearing that salmon were also caught by fishing with a fly near the base of the dam.

Preface

The Atlantic salmon was given its Latin name, *salar*, meaning leaper by the armies of Julius Caesar. It was scientifically named *Salmo salar* by Linneaus in 1758. The Atlantic salmon has been eagerly sought by the Celts, prized by the Romans, protected by royal decree, and immortalized in writing, from the carvings made by the cavemen of the Pyrenees nearly 12,000 years ago to the recent works of Anthony Netboy.[1,2]

The writings of Netboy summed up the demise of the Atlantic salmon in New England during the colonial era. A manuscript, prepared by William C. Kendall,[3] entitled "New England Salmons," published in 1935 described the life history of the Atlantic salmon in vivid detail, and briefly discussed early attempts to restore the salmon. Today a great many popular articles appearing in such magazines as *Trout*, *Fly Fisherman*, *New England Outdoors*, *Gray's Sporting Journal*, *Yankee*, and the *Atlantic Salmon Journal*, have addressed the current Atlantic salmon restoration programs in New England. Unfortunately, few have done more than touch upon the restoration efforts that were so important in the latter part of the 19th century. In all cases the early attempts to restore salmon to rivers such as the mighty Connecticut and the somewhat smaller Merrimack were characterized as miserable failures.

The endeavor undertaken in the Connecticut River was indeed a failure. Over-fishing within the river, and the lack of fishways at the various dams were the two most important factors leading to the abandonment of the project. The following quote from the New Hampshire Fish and Game Commission in 1878 describes the status of the restoration effort in the Connecticut River at that time:[4]

> "It is the pounds and gill-nets at the mouth of the river which have rendered all labors on the Connecticut useless, and, until, the legislature of Connecticut abolishes them and gives the fish an opportunity to ascend the river, neither Massachusetts nor New Hampshire proposes to spend any money in stocking that stream."

Whether or not the restoration attempt on the Merrimack River was a total failure is debatable. In the sense that salmon do not inhabit the river today, the effort was a failure. However, we do know that the restocking of the Merrimack River did culminate in the return of adult salmon annually for nearly twenty years. The size of these runs could easily have numbered in the thousands. The restocking of the Merrimack River may not have been nearly as futile as depicted by many. Just how successful was this endeavor to restore the Atlantic salmon to the Merrimack River? Hopefully, this question will be answered within the pages of this book.

Fortunately the records kept during that time period, for the most part, were very good. Not only was the written work of the early salmon pioneers available, but so too, were a great many photographs[a] depicting the Atlantic salmon in New England. However, as with so many things, the writings and the photographs have been gathering quantities of dust in obscure places for many years. Man has almost always profited from his past, but in attempting to restore the Atlantic salmon, we have thrown the past aside. The work that the Fletchers, the Powers, the Atkins, the Holmes, and the Hodges did in the face of enormous odds, and the results they achieved, for all practical purposes have been forgotten.

In my endeavor to tell the story, "The Forgotten Salmon of the Merrimack," I have attempted to be as accurate as possible. However, it has been necessary to speculate from time to time. The greatest amount of speculation centers around the size of the salmon population in the Merrimack River, historically, and during the restoration effort.

The reasoning used in developing the salmon population size, historically, is presented in Appendix II. Those estimates pinpointing the population of Atlantic salmon during the early restoration attempts utilize a number of factors: monthly rainfall (Appendix III); the fry stocking program of the period, data collected from the Penobscot River in Maine during the late 1920's and early 1930's; and the fish counts that were obtained at the fishway at the Lawrence dam (Essex dam) during the restoration effort itself. Appendix IV contains a detailed description of the methods and results. Within Appendices V and VI, the reader will find additional historical data.

The speculation within this manuscript is mine alone. It is my opinion as to what may have occurred in light of the events and the available records.

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a) These photographs, dating back to the late 1800's, have been utilized throughout this manuscript to help clarify many of the events. A number of photographs have also been included within Appendix I because of their general interest value as well as their historical significance. The historical photographs were taken, in most cases, by Charles G. Atkins, an employee of the United States Fish and Fisheries Commisssion. All other photos, unless otherwise noted, were taken by George Perry of the United States Fish and Wildlife Service.

Acknowledgements

The writer is most grateful to the New Hampshire Fish and Game Department who provided a great deal of information critical to the completion of this effort. The Massachusetts Division of Marine Fisheries also supplied numerous historical accounts. I am indebted to the Vermont Fish and Game Department who permitted Philip Wightman, Regional Fisheries Biologist, to accompany George Perry and myself in our quest to find many of the historical sites and structures along the Merrimack River. Both the Public Service Company of New Hampshire and the Concord Electric Company (Concord, New Hampshire) were helpful in providing information.

My sincerest thanks are extended to Robert C. Learned of Rumney, New Hampshire who provided background information about his great uncle, Elliott B. Hodge.

Alfred L. Meister, Chief Biologist for the Maine Atlantic Sea-run Salmon Commission, kindly offered suggestions during the manuscript's preparation.

A great deal of appreciation is extended to the following individuals, who supported this effort through critical review and comment: Dan Kimball, David Allen, Gerald Marancik, and John Nelson of the United States Fish and Wildlife Service; Peter H. Oatis of the Massachusetts Division of Fisheries and Wildlife; Howard C. Nowell and Charles F. Thoits of the New Hampshire Fish and Game Department; Richard Seamans, Jr. of the National Marine Fisheries Service; Arthur Newell (former employee of the New Hampshire Fish and Game Department); and Philip H. Wightman of the Vermont Fish and Game Department. The author is extremely grateful to Bill Whalen, Herb M. Holmes, Debra B. Prescott, and Michael P. Coleman of the Office of Public Affairs (USFWS).

And lastly, my sincerest appreciation is extended to George A. Perry (Office of Public Affairs - USFWS). The manuscript could not have been completed without his assistance. Mr. Perry was instrumental in providing many of the current photographs, the illustrations, and some of the research material that was critical to the development of the story. His enthusiasm was as strong as mine throughout the entire project.

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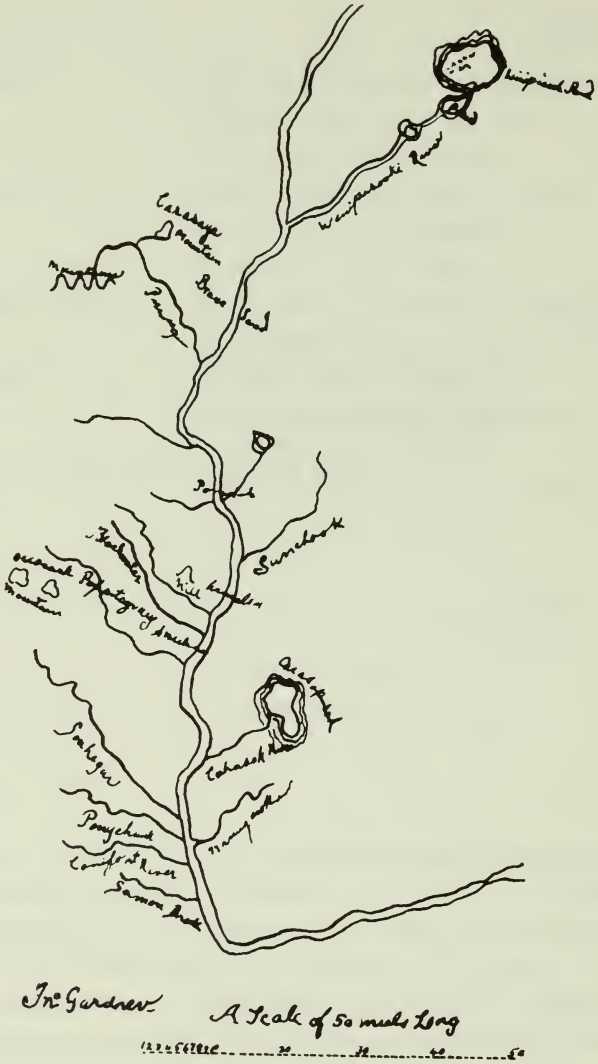
Introduction

"A silver band, the Merrimack
Links mountain to the sea;
And as it runs, this story
It tells to you and me."
Nellie M. Browne (Circa 1906)

If we had traversed the Merrimack River Basin 400 years ago, a heavily forested area, with clean, unhindered waters, abundant game and fish, and of course, the Atlantic salmon would have unfolded before us. The basin, first surveyed by Goodman Woodward in 1638, is the fourth largest in New England, occupying some 5,000 square miles.[5] Formed by the marriage of the Pemigewasset River, a crystal clear stream originating in Profile Lake at an elevation of 1,900 feet, and the Winnipesaukee River, that has its source in the lake of that name, the Merrimack River, passes through the central and southern portion of New Hampshire and the northeastern portion of Massachusetts.

The climate of the basin was probably much like it is today, temperate, characterized by moderately warm summers, cold



THE GARDNER SURVEY OF THE MERRIMACK RIVER, 1638

Figure 1. A reproduction of the map drawn from the Woodward survey of the Merrimack River in 1638. Redrawn here by George Perry. Original map drawn by Gardner.

winters, and ample rainfall. Especially severe weather conditions may have occurred in the upper tributaries, since the region lies in the path of the prevailing westerlies and the cyclonic disturbances that cross the country from the west and southeast.

The only human inhabitants of the region, the Indians, had given the river a number of names, each denoting some particular feature of various sections of the Merrimack.[6] The name, Merrimack (merruasquamack), which has outlived all other names, means the "swift water place" and it is suspected to have originally applied to that portion of the river between Garvins Falls in Bow, New Hampshire, and Pawtucket Falls at Lowell, Massachusetts. Another name, Kaskaashadi, meaning "the place of broken waters," may have also referred to that same section of the river. The name, Namasket, meaning the "high place for fish," refers to that part of the river from Bow to the Souhegan River in the present town of Merrimack, New Hampshire. This name survives today, having changed from Namasket to Namoaskeag to its present name, Amoskeag — the highest falls of the river. These falls were located in the vicinity of the Amoskeag Dam in Manchester, New Hampshire.

In order to survive, the Indians of the river valley depended upon the fish and wildlife resources of the basin. In the spring following the long winter months, the Atlantic salmon provided a time for celebration and feasting. These early fishermen pursued the salmon at such places as Pawtucket Falls (once the capital seat of the Indians[7]), and the falls at Amoskeag, Hooksett, and Penacook. There were in fact, fourteen sets of falls on the mainstream of the Merrimack River where the natives could have fished for salmon: Whipples Falls, Pawtucket Falls, Wicasuck Falls, Taylors Falls, Cromwell's Falls, Goffs Falls, Amoskeag Falls, Hooksett Falls, Garvins Falls, Sewalls Falls, Webster Falls, Bristol Falls, Bridgewater Falls, and Livermore Falls.[8]

Atlantic salmon entered the Merrimack River during the spring following the snow and ice melt.[9] Runs probably began in April and peaked in June with some fish entering the river throughout the summer months and into the early fall. Spawning occurred during late October and November with the deposited eggs remaining within the clean gravel beds of the spawning grounds throughout the

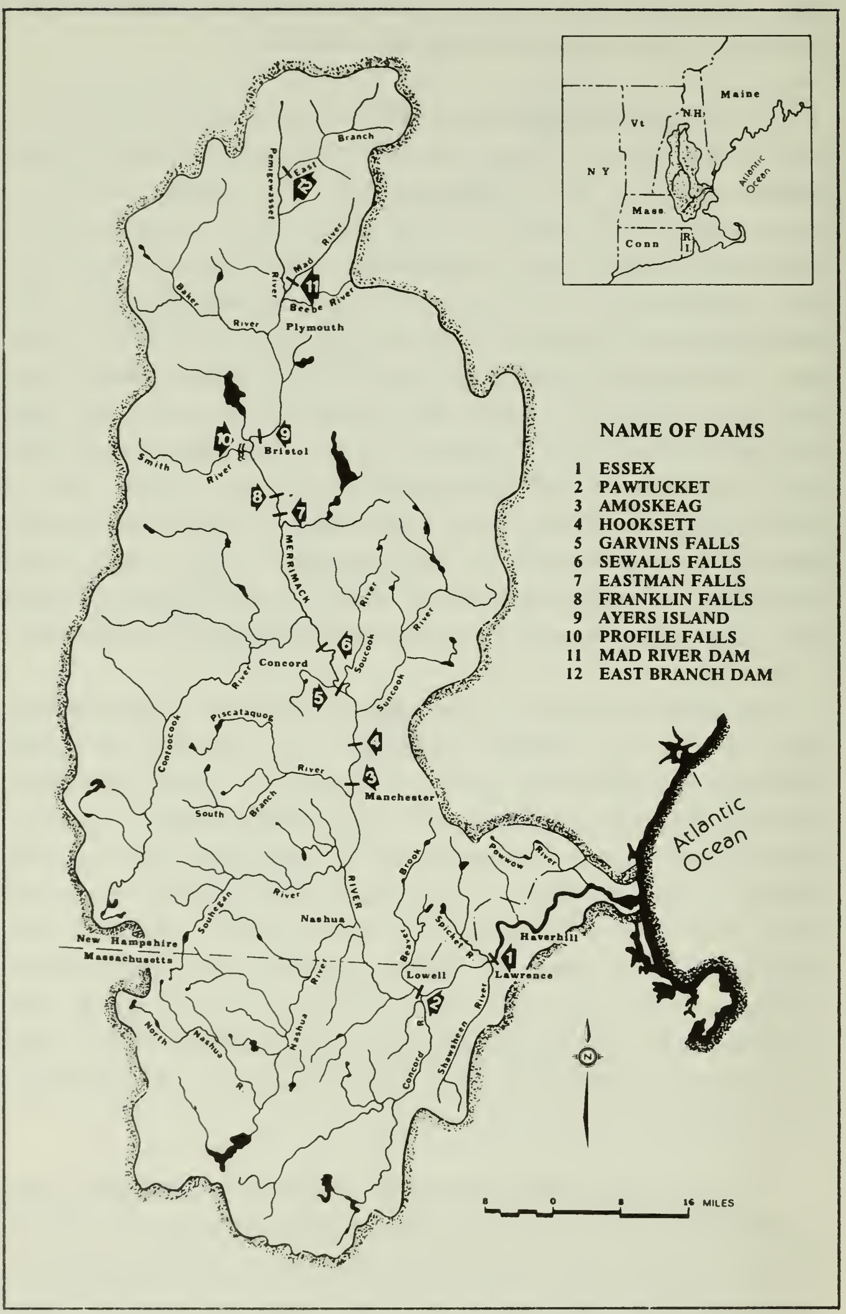


Figure 2. The Merrimack River basin of today has changed a great deal in physical appearance from that depicted by Gardner in 1638.

winter months, hatching sometime during March and April. The young salmon, called fry, emerged from the gravel beds in April and May. These hardy little fish, soon to be called parr, remained within the river system, feeding and growing for one, two, and three years. A two-year freshwater residence was probably the more typical occurrence. At four to eight inches in length these young salmon, now called smolts, then made their way to the sea. This downstream movement of the salmon may have occurred during the fall and the spring. However, the months of April, May, and June were probably the more important migrational time periods. The salmon spent from one to three years in the ocean, often reaching sizes greater than 20 pounds, and then returned to the Merrimack River. Of the adult salmon that returned to the river, the greatest percentage had spent two years in the sea.

The abundance of Atlantic salmon entering and reproducing within the Merrimack River is conjecture. The records that are available are those of the colonists, which existed prior to the extermination of the salmon population. In a special report submitted to the General Court through the Governor and his Council in 1866, by the first Fish Commissioners of Massachusetts, Theodore Lyman and Alf. A. Reed, the abundance of salmon in the river is inferred.[10] The report indicated that in the 1700's vast numbers of salmon reached the Pemigewasset River annually and that each family living near the stream salted away about 100 salmon yearly. The areas where the salmon would lie and rest in the river were all numbered, and the fishermen were reported to have certain customs and rights in these spots. In the lower waters of the River, one fisherman, Charles Ramsay of Amesbury, Massachusetts, using a 90-yard seine, customarily harvested 60 to 100 salmon a day during the peak of the salmon run. He once took 18 salmon in a single haul, and even saw up to 24 taken at one time.

The diary of Matthew Patten[11] of Bedford, New Hampshire provides even more insight into the abundance of Atlantic salmon in the Merrimack River. Matthew Patten fished for over 30 years at Amoskeag Falls and recorded many of his catches as well as the events that took place in and around the falls. Several excerpts from Mr. Patten's diary follow:

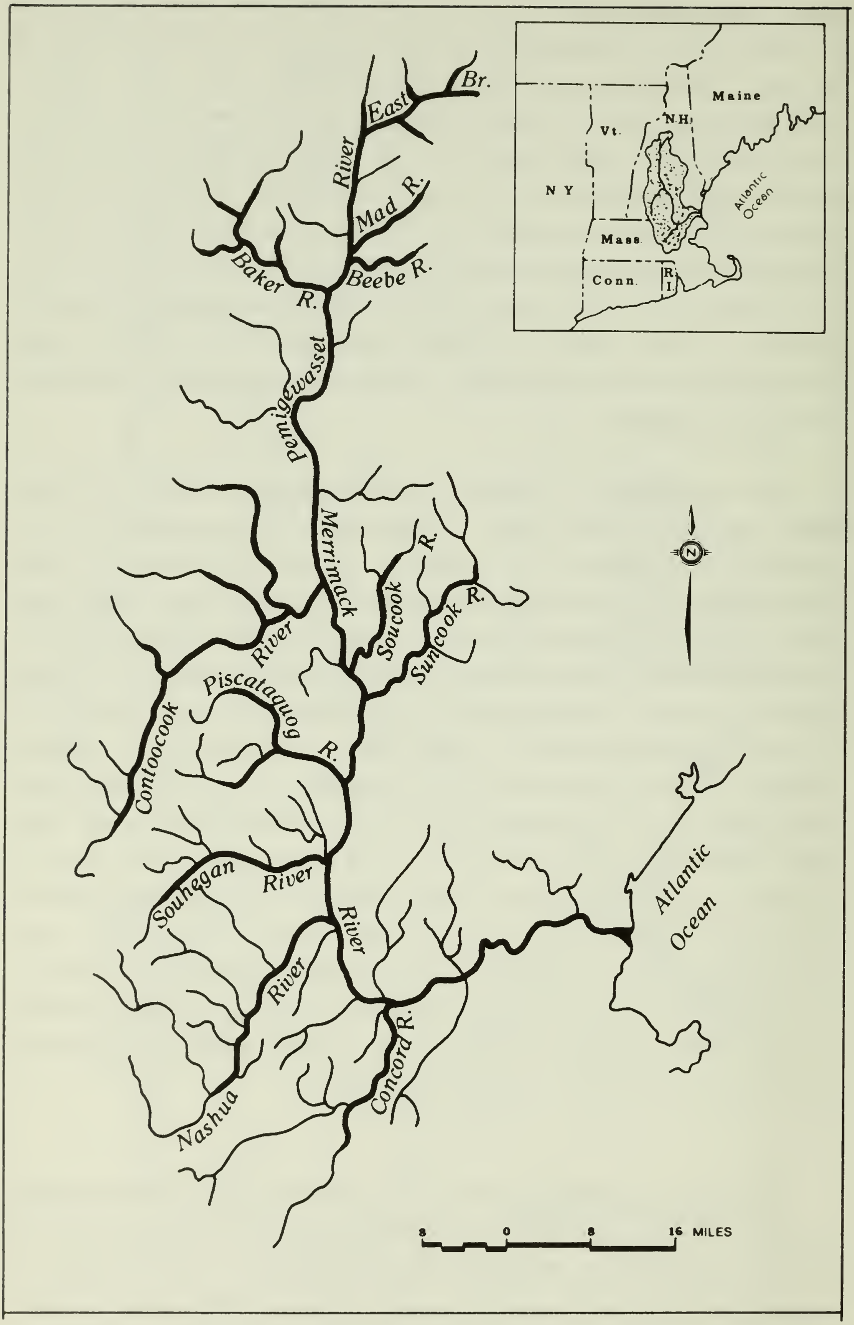


Figure 3. Those portions of the Merrimack River basin believed to have been important to the Atlantic salmon prior to 1700 are depicted by the darkened areas.

> "...took 3 depositions for Archibald Starke and a pint and a jill of rum and a mug of cyder at Tho Halls and got 44 lbs of salmon for my part" --May 31, 1758. "I fished at Amoskeag and I got about 550 shad home and a small salmon home and I changed 120 for two bushell of salt, 20 I sold, 27 I gave away and 11 I had stole" -- May 28, through 31, 1766. "We got 7 salmon and I got 2 that weighed 17 pounds. I am 3 lb behind and Tho MacLaughlin is one pound behind James Patterson" -- August 1, 1768.

It would appear that Matthew Patten was, at least in 1768, engaged in a salmon fishing contest.

It is interesting to note with respect to the fisheries at Amoskeag Falls that,[8]

> "...one man had equal rights with another; the rule which secured the rights of each being tacitly understood and generally respected, any infringement being settled on the spot by what was termed 'Scotch Argument'."

However the 'Scotch Argument' was not always utilized to settle disputes. Matthew Patten, on June 1, 1771, after having found another fisherman using his "rightful" fishing spot was able to secure from the gentleman between 50 and 100 pounds of salmon — probably a reasonable payment in order to avoid the outcome of the 'Scotch Argument'.

The following quote from an address given by Doctor Spalding to the Fish and Game League of New Hampshire in 1877, further illustrates the abundance of salmon within the river:[12]

> "Lieut. Josiah Brown, who lived at Plymouth between 1764 and 1818, was accustomed to go up to Little's, now Livermore's Falls, on horseback, at night, and return in the morning with a couple of meal-bags filled with salmon, which he had taken with the spear. Mr. Edward Taylor, who lived at Campton, some miles above Plymouth, stated that salmon were formerly so plenty at Taylor's eddy,

> near an island that if they would lie still he could walk accross the river on their backs, without once touching the bed of the stream. Daniel Webster told Hon. George W. Nesmith, that in his boyhood salmon were so abundant that fishermen used to bring large quantities to his father and sell them at three cents per pound, not for cash, but in exchange for corn. It is related of widow Hemphill, who lived near the mouth of the Suncook, at Garvin's Falls that on one occasion she assisted in spreading the net, and at one haul took eighteen salmon. Col. Wm. Kent told my informant that in 1817 a party from Concord, escourted President Monroe in a boat-ride down the river, and in passing through the locks in Bow a large salmon was caught and taken on board alive and kicking, and presented to the president, who expressed great pleasure, saying he had never before seen a live salmon."

It is undoubtedly an exaggeration that the salmon were so abundant within the river, that one could have walked across their backs without even touching the bed of the stream. However, one can make an educated guess as to their numbers utilizing our present-day knowledge, provided that the distribution of the salmon within the basin is known. Records indicate that these fish frequented the Pemigewasset River, whose major tributaries were the East Branch, the Mad River, the Beebe River, and the Baker River, and also entered the Contoocook River, the Soucook River, the Suncook River, the Piscataquog River, the Souhegan River, the Nashua River, and the Concord River.[13-17] Although there may be some question as to whether salmon actually traveled the Concord River, there is no reason to believe that they did not.

The size of the salmon population, it would seem, was determined by the amount of suitable habitat, habitat that provided the necessary ingredients for successful spawning and the rearing of young fish to the smolt stage. Based on quantification work accomplished in 1963 (nearly seven million square yards of suitable habitat were measured)[18], and the fact that a great deal of the pre-colonial habitat was inundated by the numerous dams and their associated impoundments in 1963, I would speculate that the historical habitat may have approached 10 million square yards.

This quantity of habitat could have easily produced 350,000 smolts and generated an adult population of 18,000. Since Mother Nature also imposed her guidelines, the adult salmon population surely fluctuated considerably from year to year. A fluctuation of plus or minus 50% is not an unreasonable expectation. Thus, it is my calculation that between 9,000 and 27,000 adult Atlantic salmon entered the Merrimack River annually. The mechanics used in developing the historical population estimate are presented in Appendix II.

Author's Note

It is important that the reader realize that the Atlantic salmon was not the only fish inhabiting the Merrimack River during the pre-colonial period. The American shad, the lamprey eel, and the alewife were also important and indeed much more abundant than the salmon.

The American shad was probably the most important of all the fish that entered the river. Throughout Matthew Patten's diary there are continual references to the shad; references indicating that these fish were not only heavily harvested, but also eagerly sought. Established documentation proves that both the Atlantic salmon and the shad reached the junction of the Pemigewasset and Winnipesaukee Rivers. The salmon entered the Pemigewasset River, while the shad entered the Winnipesaukee River.[15] Although shad were harvested throughout the mainstem of the Merrimack River, they were also harvested in the Winnipesaukee River, and in some cases depended upon for food. One account in the late 1700's relating to the Laconia — Meredith, New Hampshire area, vividly depicts the importance of the shad.[19]

> "One year there was a scarcity of food, and Priest Folsom was talking in the church, when someone entered and said, 'The shad have come. The shad have come.' Priest Folsom said, 'The shad have come. I close my sermon. They will do you more good than my talk.' The men all rushed down the Shad Path to the weirs."

The American shad must also have been plentiful, because they were literally harvested by the thousands. One particular story in the New Hampshire Gazette (May 23, 1760) tells of a spectacular catch of shad, and I quote:[8]

> "One day last week was drawn by a net, at one draught, two thousand five hundred odd shad fish out of the river Merrimack. Thought remarkable by some people."

The lamprey eel, which today is looked upon as nothing but a menace and is utilized by virtually no one, was however in the colonial times, a source of food for some. They were harvested intensively at the Amoskeag Falls by the early settlers, amusingly described in the following verse:[20]

"From the eels they formed their food in chief,
And the eels were called the Derryfield beef;
It was often said that their only care,
And their only wish and their only prayer,
For their present world and their world to come,
Was a string of eels and jug of rum."
William Stark (Circa 1883)

The alewives too, were utilized by the early settlers, and in the vicinity of Hudson, New Hampshire, provisions were made to permit these fish free passage into ponded areas on small tributaries for the purpose of spawning.[20] Thus, the settlers were assured of a continual supply of fish.

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Chapter One

Chapter One:
Annihilation and Restoration

"By thy fair stream
The red man roams no more.
No more he snares
The artful trout, or lordly salmon spear;
No more his swift-winged arrow strikes a deer."
Anonymous (Circa 1906)

The Atlantic salmon passed freely to and from the Merrimack River for thousands of years, confronting its enemies throughout, and in the late 1700's, a further confrontation, the Industrial Revolution. The colonists not only utilized the salmon, a resource the river provided, but employed the river itself, to run their sawmills and gristmills. This early development centered within the tributaries, and had little impact on the salmon. However, by the middle and late 1700's the inhabitants of the Merrimack River valley were focusing upon the raw power of the Merrimack River mainstem.

Since the city of Boston was becoming a thriving community and a center for trade with the Merrimack River valley area, and since overland travel was both tedious and expensive, the river offered a viable transportation possibility. Just prior to 1800, this alternative was being tested and diversion dams and locks were built on the Merrimack River at Hooksett, Goffs, Moore's, and Cromwell's Falls in New Hampshire, and at Pawtucket Falls in Lowell, Massachusetts.[21] The locks and canals at Manchester, (Amoskeag Falls) were not however, actually completed until May of 1807.[22] By 1812, the mainstem of the river was being utilized for the transportation of people and goods upstream to the wharfs in Concord.

By the middle of the 19th century, the cities situated along the river had grown tremendously in manufacturing. It was said that the Merrimack River turned more machinery than any other river in the world.[22] It was estimated that one-sixth of all cotton and wool carpets, one-fifth of all the woolen and cotton goods, and over one-fourth of all cotton fabrics manufactured in the United States were made in the Merrimack River valley. The following verse describes the situation aptly:

"Unchanged and changeless flows the river,
But blended now with its ceaseless chime
Is the rhythmic beating of mighty hammers,
And a hum like the bees in summer time.

But the hum of the looms and the clank of the hammers,
Will hush to the Chime of the Sabbath bells,
While the soul of the stream from the Lake of the Spirit
The story of Eliot's Master tells."
From 'At The Falls of Namoskeag'
Allen Eastman Cross (Circa 1906)

At the same time manufacturing was flourishing, the runs of Atlantic salmon entering the river were beginning to decrease. Many of the salmon were able to negotiate the locks and canals, but were unable to proceed above Bristol, New Hampshire after 1820, because of a newly constructed dam. Thus, the fish was denied access to its all important spawning grounds. In 1830, a diversion dam was partially constructed at Sewalls Falls just above Concord.

The first complete dam at Amoskeag was built during the early 1830's. Interestingly enough, the state of New Hampshire required that a fishway also be constructed, and despite the fact this type of concern was unusual, it was built at the Amoskeag Dam. This fishway was the first in New Hampshire and on the Merrimack River. Why a fishway had not been required at the dam in Bristol is unknown. However, the fishway at the Amoskeag Dam and the lack of a fishway at Bristol, are relatively unimportant, because in 1847, a 30-foot high dam in Lawrence, Massachusetts was built. Since this was the first dam on the river, it denied the salmon and all other anadromous fish access to the entire upriver areas. Within a relatively short time thereafter, the Atlantic salmon no longer entered the river and thus, the Merrimack River Atlantic salmon population became extinct!

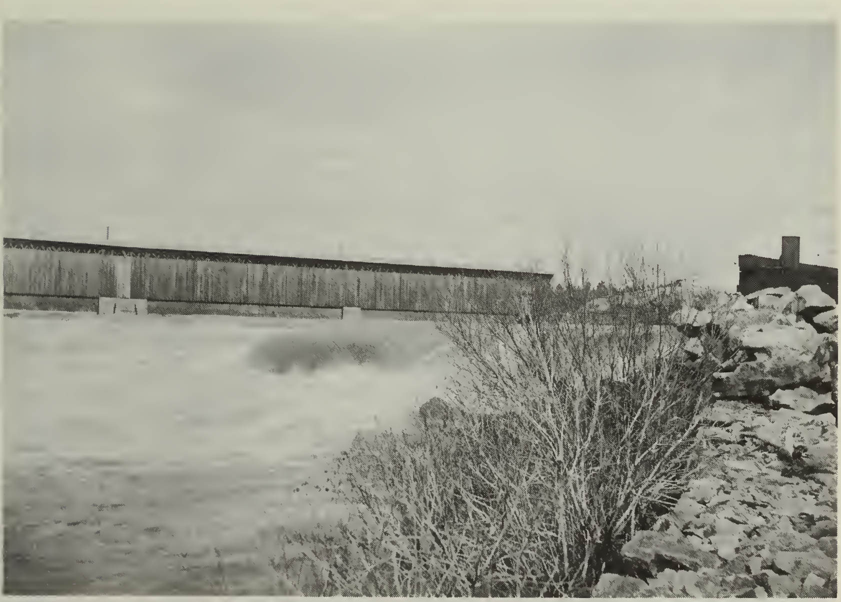

Figure 4. This picture, courtesy of the Public Service Company of New Hampshire, shows the Hooksett Dam in the late 1800's. This structure probably provided little hinderance to upriver migrating salmon.

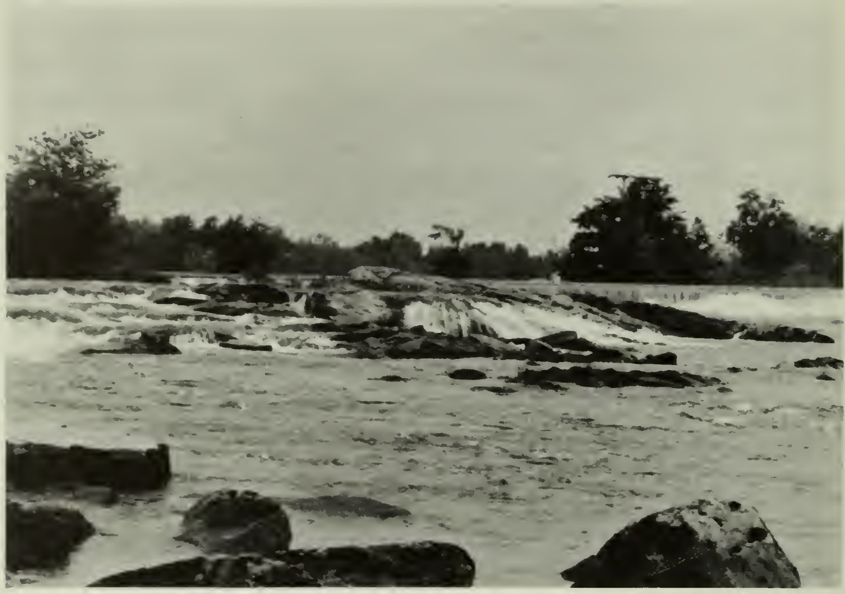

Figure 5. The Hooksett Dam today, has changed considerably from that depicted in the late 1800's.

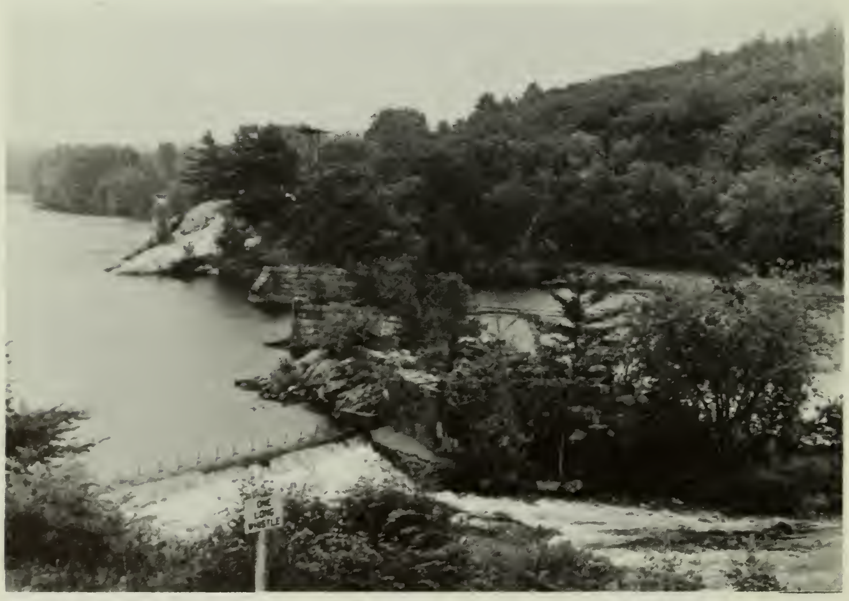

Figure 6. Another view of the Hooksett Dam, northeast of the existing railroad bed, shows the foundations for the old covered railroad bridge.

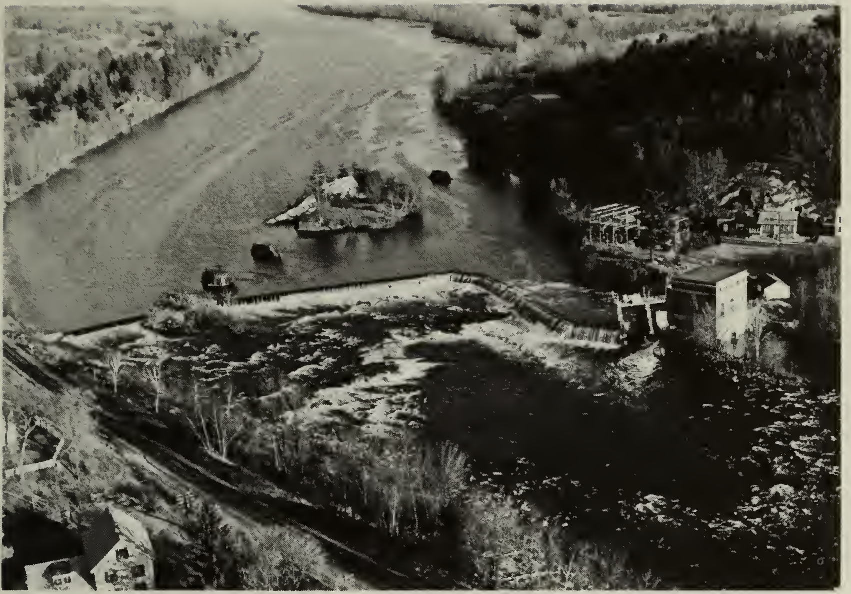

Figure 7. This aerial photo shows the complexity of the area today. At least two and possibly three fish passage facilities will be required. Photograph, courtesy of Wayne Nelson of the Public Service Company of New Hampshire.

The harvesting of Atlantic salmon during the period of rapid development of the Merrimack River valley, dramatically reaffirms the decline of the Atlantic salmon population. In 1805, a good catch amounted to 20 salmon per day, per fisherman, and by 1830, a catch of 10 salmon per day was exceptional. By the 1850's, no salmon catches existed. The decline in the economic value of the commercial salmon fishery subsequently followed.[10] The estimated value of the fishery in 1789 amounted to 38,000 dollars, in 1805, to 9,500 dollars, in 1835, to 4,750 dollars, and after 1850, the value was projected at only one dollar. These estimates refer solely to the harvest of salmon in the Lawrence area.

There were however, individuals that were genuinely concerned about the fate of *Salmo salar*. A New Hampshire Fish and Game Commission report issued in 1857 alludes to this in the following quote:[23]

> "Indeed, it is fully established, we think that if care be taken to prevent and restrain the erection of obstacles to the ascent of these fish from the salt to the

> freshwaters, for the deposition of their spawn, and if protective laws be rigidly enforced to render impossible the wanton destruction of the breeding flesh on their spawning beds, and during the season when their flesh is not only valueless but actually unwholesome, while they are engaged in the process of breeding, or are returning, spent, lean, large-headed, flaccid, and ill-conditioned, to health and reinvigorating their system, by the marine flood, whence they derive their excellence – there is no limit to their reproduction or increase, allowing every fair and reasonable use of them, whether for local consumption or for foreign export.
>
> Should suitable fish-ways be placed upon the dams erected on these streams, and proper laws enacted to prevent the destruction of fish at certain seasons of the year, there can be no doubt that in a conservatively short time our large rivers would be again stocked with shad, and even without the aid of artificial propagation; but as regards salmon, this fish had been so effectually driven from our rivers, that artificial means would be required to bring him back; and this is neither so difficult or expensive as might at first seem probable."

The initial efforts to restore and improve the fisheries of the rivers and inland waters may have originated in New Hampshire in 1864, with Henry A. Bellows, of Concord. He secured from the legislature, resolutions providing for the appointment of commissioners to investigate the restoration of migratory fish to the Merrimack and Connecticut Rivers. He also requested the states bordering the two rivers, pursue a similar examination.

Mr. Bellows and W. A. Sanborn were appointed by the New Hampshire legislature in 1864 as the first Fisheries Commissioners for the state. In 1865, Bellows represented the State before a joint committee of the Massachusetts legislature and this committee meeting lasted for four days. Professor Agassiz, the distinguished naturalist, and others from the scientific community, addressed the committee specifically with regard to the restoration of anadromous fish, notably the Atlantic salmon, to the Merrimack River and the Connecticut River. The hearing produced a report entirely favorable to the restoration.

The soon-to-be restoration effort became a joint New Hampshire and Massachusetts reality that same year. The Massachusetts legislature authorized and funded the Massachusetts Fisheries Commission; the first Commissioners, as indicated earlier, were Theodore Lyman and Alfred A. Reed, who worked hand-in-hand with the New Hampshire Fish and Game Commission in the joint effort. The year, 1866, was to be a new beginning for the Atlantic salmon!

Author's Note

During the period of rapid industrial development, the Atlantic salmon decreased with rapidity in the Merrimack River valley,a) while the American shad population remained rather high in numbers. The shad did not depend on reaching the headwater areas for spawning, but utilized the mainstem of the river and were consequently able to sustain their numbers more easily than the salmon.

The impact, however, was dramatic for the shad when the dam construction was completed in Lawrence in 1847. This is shown, graphically, in the estimated values of the commercial fishery (Lowell and Lawrence area) in 1789, 1805, 1835, 1865; representing 830,000 dollars, 540,000 dollars, 365,000 dollars, and 50,000 dollars, respectively.[10]

It is interesting to note that although the dams were reputed to have been the chief cause for the decline of the anadromous fishes, other factors including the destruction of young fish by the millwheels and water pollution, contributed to the decline.

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a) Although industrial development within the valley was greatly influenced by the construction of the canals and locks, the coming of the railroad in 1842, was the principal contributor.[22]

Chapter Two

Chapter Two:

Restoring The Atlantic Salmon - The Initial Effort

> *"We employ the latest discoveries and the cunningest inventions of genius; we establish schools and lavish public and private resources to restore and maintain the productive power of the land; why should we be less generous to the more fertile acres of our inland seas, the common domain of rich and poor? Are not their fruits equally the gift of heaven for the support of man? We replenish the exhausted earth that we may reap more abundant harvests; why not the exhausted rivers?"*
>
> The New Hampshire Fish and Game Commission

The first duties of the Massachusetts Fisheries Commissioners in 1866, involved examining the dams on the Merrimack River, specifically the Essex and Pawtucket dams, and subsequently devising a plan for the construction of fish passage facilities. The plan of action was to be submitted to the New Hampshire Fish and Game Commission and upon approval was then to be presented to the proprietors of the two dams. Suitable fish passage facilities were then to be built within a reasonable amount of time which the Commissioners determined. The Massachusetts law did indeed have some teeth in it. If a proprietor refused to begin construction of the fishway within a 30-day period after the issuance of the order, the state could order the work contracted and expenses be recovered from the owner by the treasurer of the state.

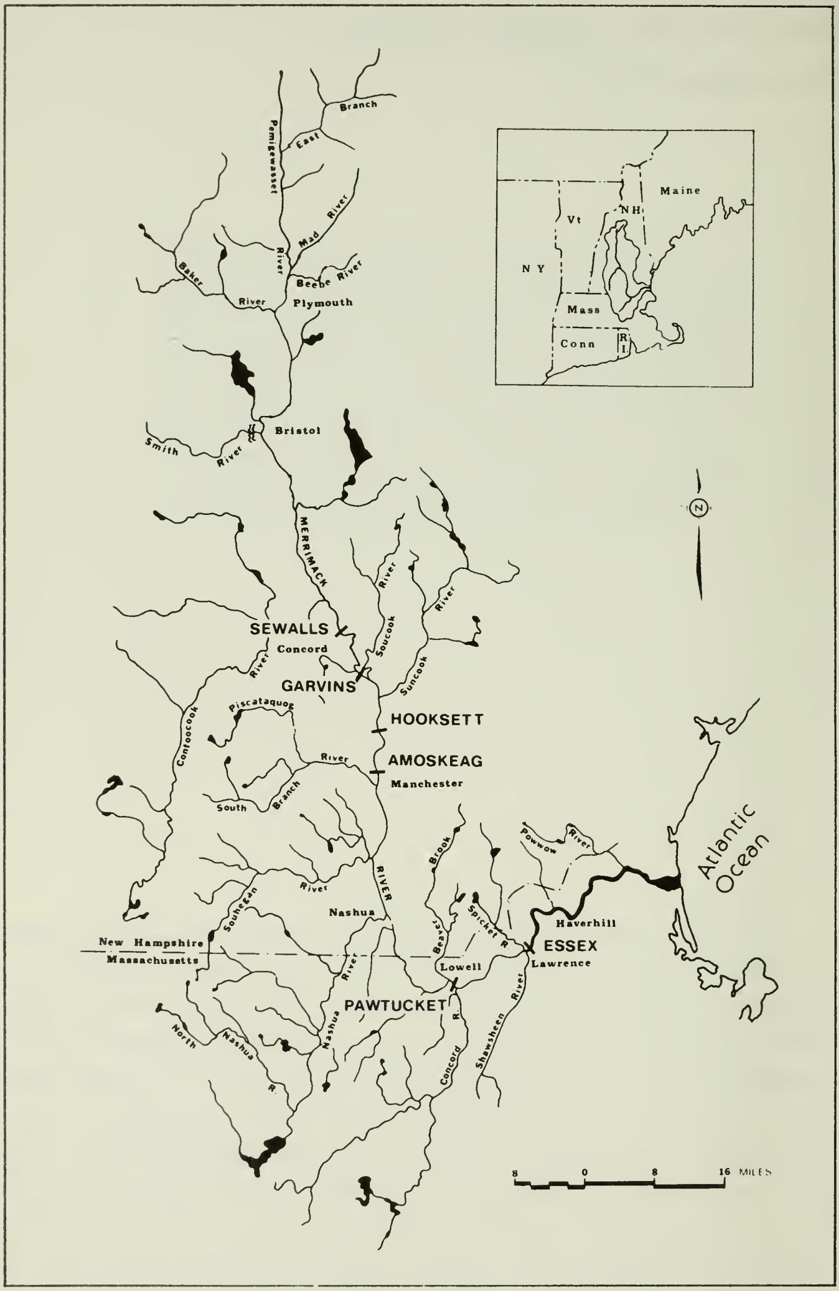

Figure 8. Although there were possibly seven dams on the mainstem of the Merrimack River in the late 1860's, only three fish passage facilities were required and present.

A legal problem developed at the Essex dam, and the state of Massachusetts consented to construct at its own expense this fish passage facility, since the proprietor of the Essex dam had constructed a passage facility previously. Although the old structure never allowed fish to pass because of its extremely poor design, his obligation was considered fulfilled.

The situation within New Hampshire was somewhat different. The state had a law for over 30 years, requiring the construction of fishways at dams considered to be total obstructions to the upstream movement of migratory fish.[a] A fish passage facility was in place at the Amoskeag dam in Manchester, and at Garvins Falls and Hooksett Falls none were required. Whether or not the diversion dam at Sewalls Falls in Concord still existed is unclear. If it did exist, it must not have been a hindrance to the migratory fish. The fate of the dam at Bristol is also speculative. If it still existed, it undoubtedly did not require the construction of a fishway.[b]

Action in the fish passage matter in Massachusetts was rapid, and by 1868, the headwaters of the Merrimack River were once again accessible to the Atlantic salmon. It was not, however, for nearly 20 years, and only after continual revision of the fishways, that they were deemed suitable and in fact highly successful.[12]

The second order of business for the Fisheries Commissioners from the two states concerned the quality of the water in the Merrimack River. Two distinguished chemists from Massachusetts were employed to describe the water quality. No evidence was found to prove the water in the river unfit to sustain fish life. The most polluted area, was the Winnipesaukee River, due to discharges from the Laconia region. However, even this was not considered a problem area and it was stated:[24]

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[a] The following section of a state statute (1873) had been in force for a number of years:

"If a person shall erect or maintain any dam or weir upon the Connecticut, Merrimack, Pemigewasset, Ammonoosuc, Winnipiseogee, or Baker's River, or any tributary of said rivers, without providing a suitable fishway, to be approved by the fish commissioners, or shall not keep open said fishway during the months of May and June, and from the twentieth day of August to the first day of November in each year, he shall be fined 10 dollars for each day's continuance of such dam or weir, or neglect to keep open such fishway."

b) If the dam was still in place, it must have been modified for in 1820, it was reported to have been a total obstruction to the upstream movement of the salmon.

> ". . . by a well-known physical law, a stream of impure water flowing into a river does not soon enter the general current, but is confined to one side and the bottom, and before becoming diffused the noxious matter is deposited or decomposed; in short, that it soon works itself clear."

In anticipation of the construction of the fish passage facilities, Dr. William Fletcher (a dentist) of Concord, New Hampshire was sent to the Miramichi River in New Brunswick, Canada during the autumn of 1866, to obtain Atlantic salmon eggs for the Merrimack and Connecticut Rivers.[a)] He was able, with the permission of the government of the Province, to accomplish the task and succeeded in obtaining approximately 70,000 eggs.

There was some uncertainty as to the best method of packaging the eggs for transportation. One method, and apparently the only successful one, involving packing some 15,000 to 20,000 eggs in moss within champagne-baskets. Although it was not stated, the eggs were probably transported by ship and rail.

Upon his return, Dr. Fletcher immediately placed the majority of the eggs into artificially-prepared beds, in suitable gravelly rapids within the Pemigewasset River. Several hundred eggs were also placed into a spring on the east side of Concord and there observed during their development by Dr. Fletcher (the spring was located at the base of a bluff on the eastern side of Concord near what was called the free-bridge road which led to Loudon).[12] Approximately 90% of these eggs hatched.[b)] During the fall of 1867, Dr. Fletcher observed a number of young salmon in the vicinity of the artificial

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[a)] During the same period that the Merrimack River was being scrutinized relative to the restoration of anadromous fish, the Connecticut River was receiving nearly, if not, equal attention.

[b)] In August of 1867, the first Fisheries Commissioner of Maine, Charles G. Atkins, visited Dr. Fletcher and described the apparatus he used in rearing some of the resultant fry on the east side of Concord. Mr. Atkin's comments as they appeared in his diary, are presented in Appendix VII.

beds within the Pemigewasset River; proof, that at least some of the eggs were of benefit.

After observing the young salmon within the Pemigewasset River, Dr. Fletcher was again dispatched to the Miramichi River, where he was able to obtain another 70,000 eggs. Nearly all of the eggs were transported to New Hampshire, where they were evenly divided between Messrs. Robinson and Hoyt and Livingston Stone. Robinson and Hoyt had a hatching-house in Meredith, New Hampshire and Livingston Stone had a hatching-house in Charlestown, New Hampshire. A great many of the eggs unfortunately, had not been properly fertilized and only a little over 5,000 were hatched at each facility. The fry hatched at Charlestown were destined for the Connecticut River, but nearly all died during extremely hot weather in July of 1868. Very few of the fish at Meredith died and during the spring of 1869, they were released into the Pemigewasset River a few miles above Livermore Falls.

In 1868, Livingston Stone, with the backing of both Massachusetts and New Hampshire, and with the help of the Province of New Brunswick, established a salmon-breeding facility. It was located on the northwest branch of the Miramichi River, eight miles above Newcastle, on the farm of Joseph Goodfellow. A hatching-house and pond with an area of nearly an acre were constructed. It was there, in the fall, that about 450,000 eggs were obtained. Mr. Stone successfully transported 178,000 eggs to his hatching-house in Charlestown. One-hundred thousand of these eggs were purchased from him by the New Hampshire and Massachusetts Fisheries Commissioners, and transported to Meredith for utilization in the Merrimack River restoration effort. However, the majority of the eggs and resulting fry perished, leaving only 1,000 fish, which were released into the Pemigewasset River as yearlings during the summer of 1870.

For undisclosed reasons, Mr. Stone was forced to abandon his enterprise on the Miramichi River in 1869. Thus, no eggs were obtained for the Merrimack River in that year, nor would any eggs be obtained the following year. The needed egg supply for the infant restoration program was definitely unstable. If the effort was to continue, this problem would have to be remedied.

Author's Note

Livingston Stone, who participated in the restoration effort in 1867, and became a very active member in 1868, was actually in the venture for profit. In 1866, he established the Cold Spring Trout Ponds at the southern end of the village of Charlestown.[25] For over a decade this hatchery, even after the appointment of Mr. Stone to the position of Deputy Fish Commissioner (United States Fish and Fisheries Commission) for the Pacific coast, maintained its place as one of the leading establishments of its kind in the United States. Trade not only extended throughout much of this country but also into Europe.

For a number of years the superintendent of the Charlestown facility was a woman by the name of Frances W. Webber. Frances W. Webber may have been the first female fish-culturist in the United States. She was reported to have been knowledgeable scientifically, as well as practically, in the art of fish culture.[25]

Noteworthy too is that the question of fish passage facility construction, in relation to responsibility, had been tested in the courts to a much greater degree than the dispute at the Essex dam would have indicated. The real challenge came on the Connecticut River in the late 1860's and was acted upon eventually by the United States Supreme Court. The following quote related to this particular incident:[26]

> "First, the decision in the case, Mass. Fish Commission v. Holyoke Water-Power Co., on the Connecticut River, settled the law in regard to migratory fishes in rivers. This decision was confirmed by the United States Supreme Court in 1872, and sets forth that a river was a public way, and the passage of migratory fish in it a public right; therefore, whoever builds a dam must furnish a passage for its migratory fish, unless expressly exempted by the legislation."

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Chapter Three

Chapter Three:
Maine Enters The Program

> *"In order to make the restoration of migratory fish a permanent and profitable achievement, a supply of ova could be obtained from the United States commission, and from other sources, at trifling expense."*
>
> Doctor Spalding

The first few years of the restoration effort may have been considered disappointing. However, the fishways at Lawrence, Lowell, and Manchester were functioning. Atlantic salmon eggs, fry and yearlings, although limited in numbers, had been released into the headwaters of the Merrimack River, and the way was cleared for the returning adults to reach the spawning grounds. The only doubtful situation was an adequate and continuous egg supply.

Fortunately the state of Maine still had populations of Atlantic salmon returning to her rivers, and in the fall of 1871, an agreement was achieved whereby eggs were procured from the Penobscot River salmon. The first shipment, 20,000 eggs, was obtained late in 1871. The eggs were hatched by Massachusetts, and the young fry (16,000) released into the Pemigewasset River during the spring of the following year. This shipment was the first of many shipments that would continue for nearly two decades.

The events that unfolded in Maine, events that made possible the continuation of the salmon restoration effort in the Merrimack River, are worthy of elaboration. Charles G. Atkins, a man of great fortitude and ingenuity, is considered the pioneer in the effort. In 1870, Mr. Atkins endeavored to find a source of salmon eggs in the Penobscot River. Several methods were considered; one, the taking of salmon from the spawning grounds and two, the capturing of salmon in the tidal reaches of the river. The first procedure would have resulted in the successful procurement of eggs, but not nearly enough to meet the demand. The second system would have provided a far greater egg procurement potential; however, it would require that any captured salmon be kept alive until fully mature. This would, in many cases, translate into several months.

Through discussions with the Fisheries Commissioners of Connecticut and Massachusetts, the latter alternative was chosen. This endeavor required that a suitable holding area for adult salmon be found. Craig's Pond in the town of Orland, Maine was chosen as the site. It was determined that salmon could be brought directly by water from the weirs that existed at the mouth of the Penobscot River.

During the summer of 1871, the operation commenced. Adult salmon were obtained from the weirs, placed into specially prepared boats, towed by rowing through five miles of salt and brackish water to Orland Village, and then up the Eastern River and four miles across Allamoosook Pond, to Craig's Pond. While being transported up the Eastern River, three sets of locks had to be negotiated. Obviously this procedure was time-consuming and necessitated a great deal of physical labor.

In 1872, the state of Rhode Island and the United States Fish and Fisheries Commissioner, Professor Baird, joined the operation. The effort was changed and expanded considerably. The major change involved the adult holding facility. A small pond in the town of Bucksport, Maine (the pond had a variety of names, Spofford's Pond, Salmon Pond, and Great Pond) replaced Craig's Pond as the

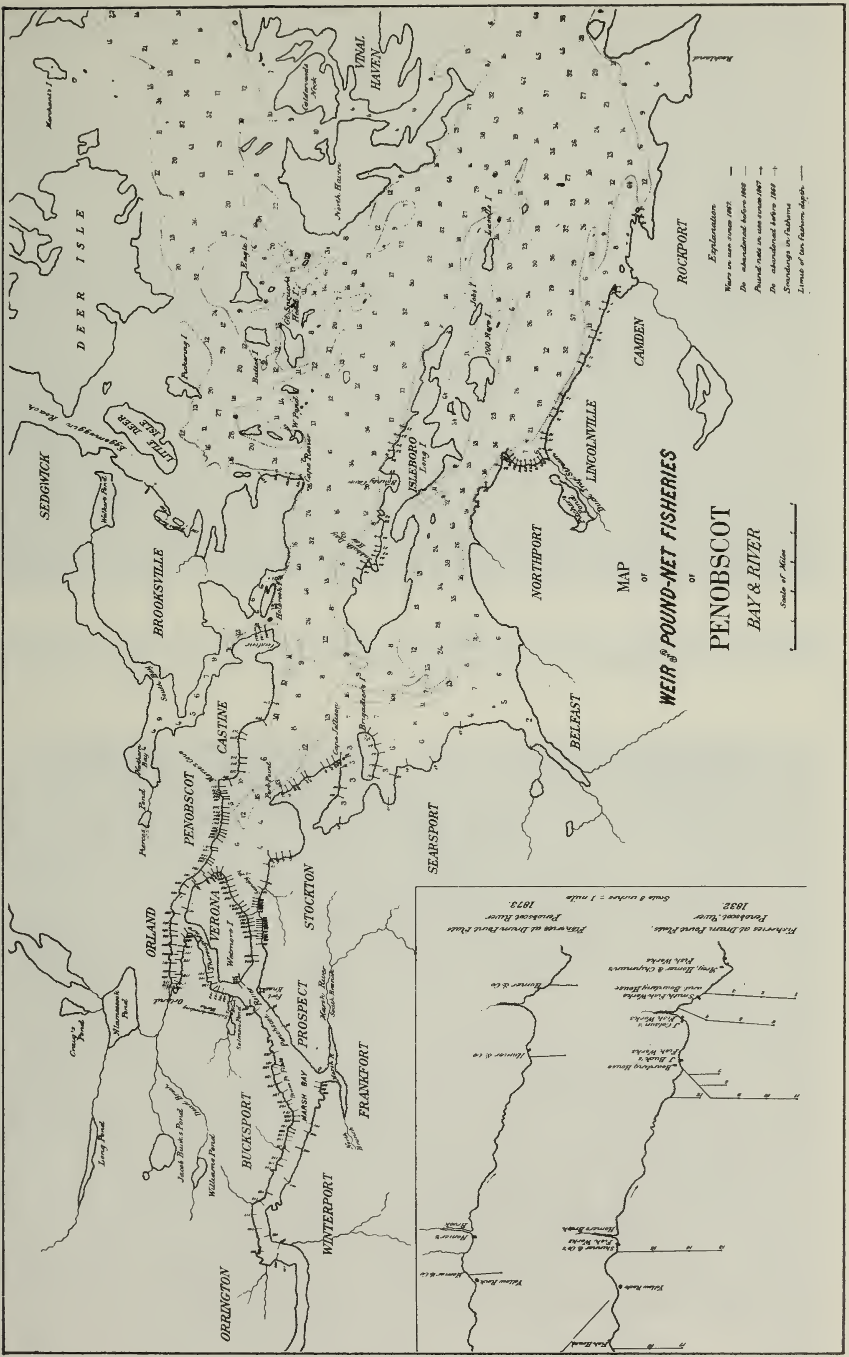

Figure 9. This map, circa 1872, shows the important features of the lower Penobscot River. It is a wonder that any salmon were able to proceed much further upstream with all of the weirs and pound-nets placed in their path.

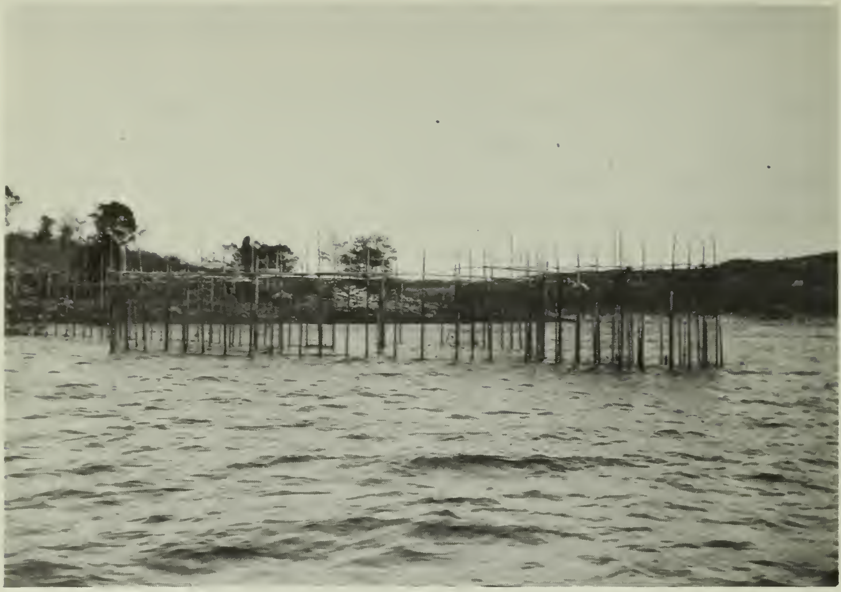

Figure 10. This weir probably represents one of the weirs from which adult salmon were obtained, for fish culture purposes. Circa 1896.

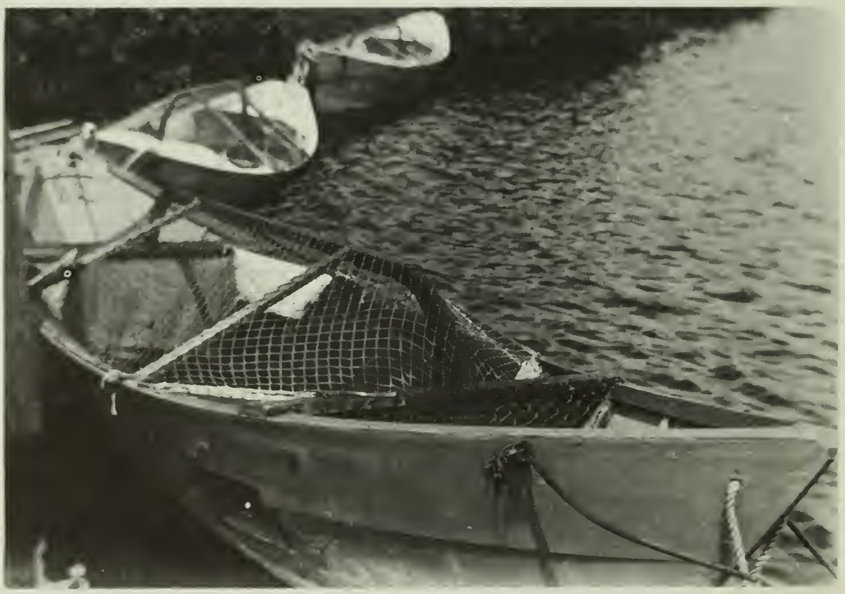

Figure 11. Several of the salmon boats (called cars) are shown here moored together. These cars were utilized in moving the salmon from the weirs to the holding facilities. (Notice the vent in the bow of the car which when open permitted water to enter freely.) Circa 1895.

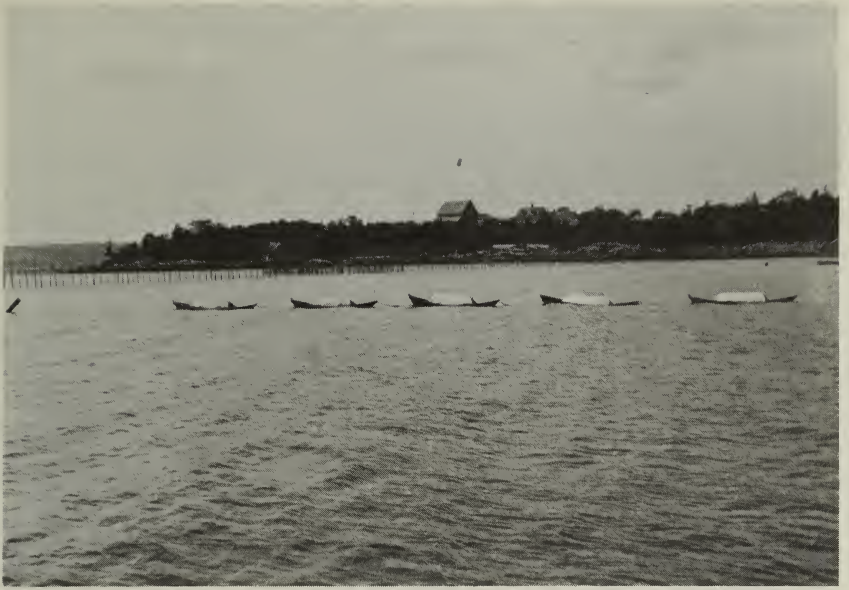

Figure 12. Five Atlantic salmon cars are filled with their precious cargo and await more favorable conditions before being towed to Bucksport. Circa 1895.

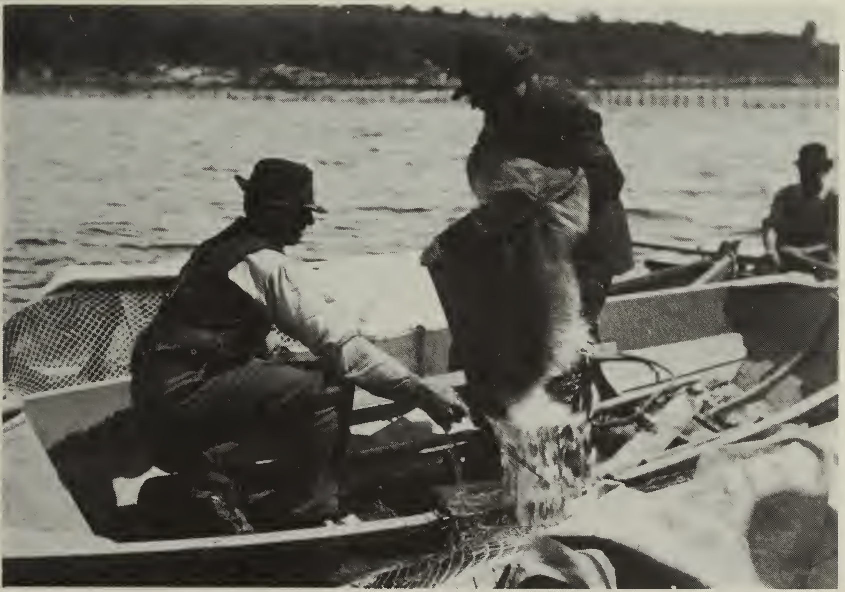

Figure 13. Salmon were often transferred from one car to another. Picture taken on June 4, 1896.

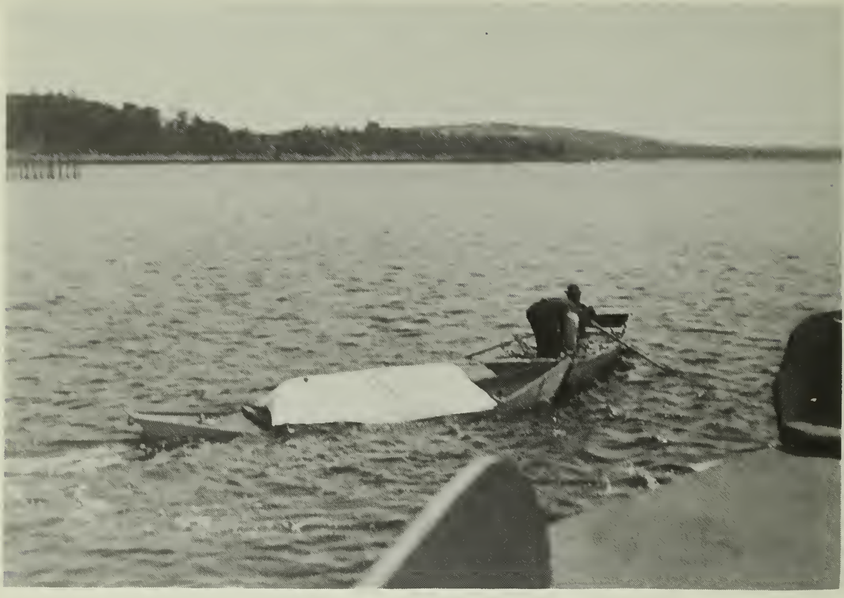

Figure 14. An Atlantic salmon car filled with adult salmon is being towed upriver. Circa 1896.

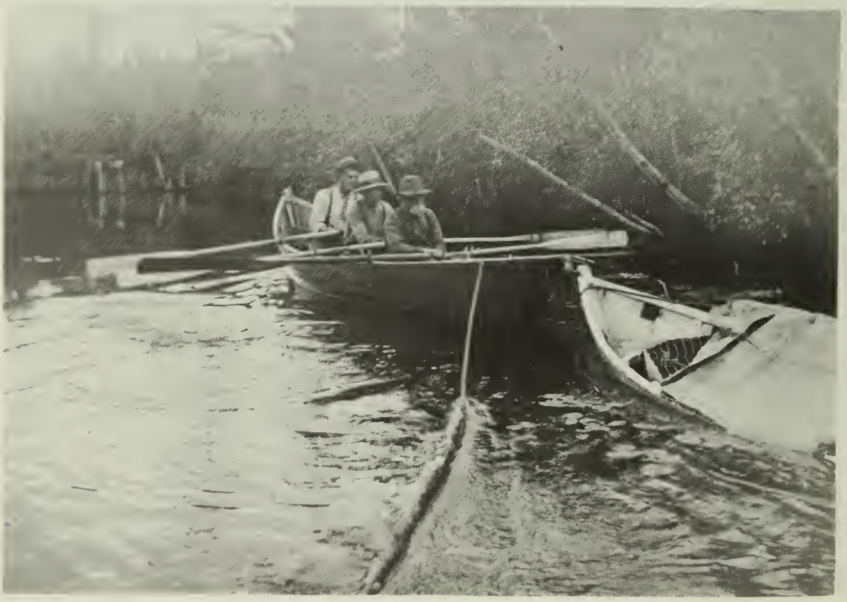

Figure 15. A great deal of physical labor was required in towing the loaded salmon cars upstream in the Eastern River. Circa 1895.

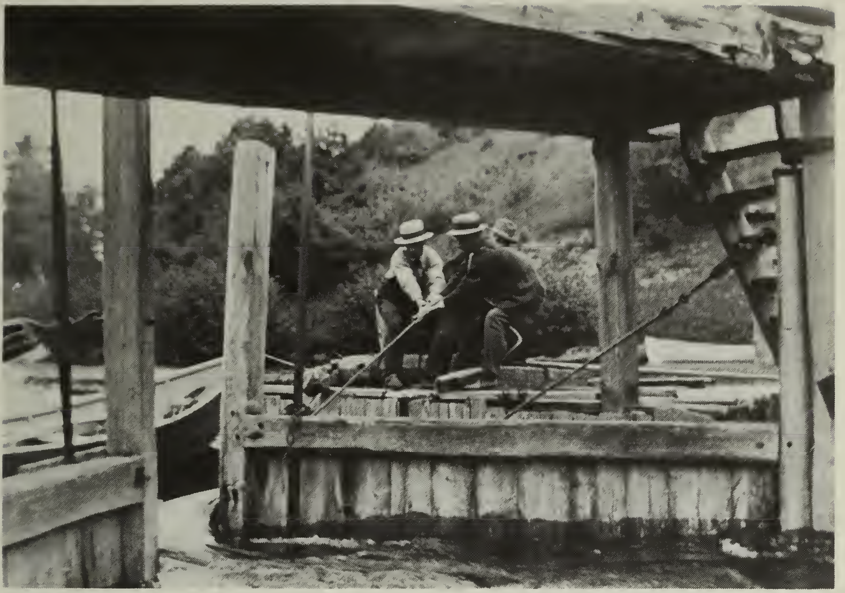

Figure 16. Three sets of locks had to be negotiated on the Eastern River. This lock is just being opened. Circa 1896.

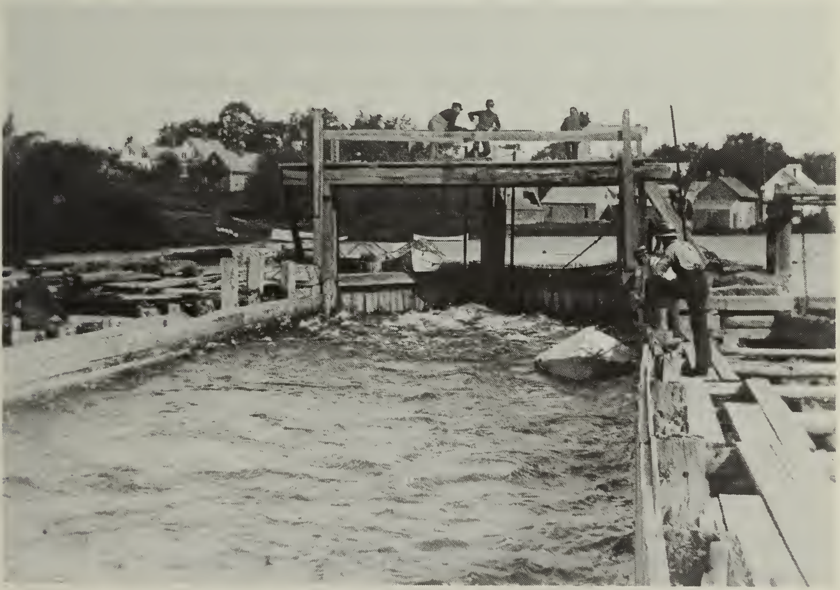

Figure 17. A single loaded salmon car is being moved through the Orland lock. Circa 1896.

adult holding area. According to Atkins, who had recently assumed a position with the United States government, the salmon procurement procedure was as follows.[27]

> "Arrangements were made with a number of fishermen to take salmon alive from the weirs and deliver them in good condition at Bucksport. They were provided with canvas bags with which to dip the salmon from the weirs to avoid the mutilation they receive from dip-nets, and with perforated boats in which to convey them to the place of delivery. . . . When the boat was depressed with the holes open it was half filled with water, and when it was in motion a current ran freely through it, while iron gratings confined the salmon within a space 7 feet long in the middle of the boat and prevented their escape through the holes. . . .The salmon boat takes the salmon from several weirs, and as soon as they are all collected, or as soon thereafter as the flood-tide takes, the laden boat is taken in tow by a dory which is propelled by wind when that is favorable, otherwise by oars, and brought to Bucksport. At first the salmon taken on the night tides were brought and delivered immediately, but it was soon found that a considerable number of them could be kept in a boat overnight when anchored in a current, and after that transportation by night was seldom attempted. The distance from the Bucksport landing to the nearest weir that furnished breeding salmon was less than half a mile, and the farthest less than five miles. They were all in the towns of Verona and Stockton.
>
> On the arrival of a salmon-boat, a dray carrying a large wooden box was backed down into the water, so that the boat could be drawn up to it, and the salmon dipped over into the box, which was partly filled with water. The box was three feet long, two wide, and two deep, containing, therefore, nearly ninety gallons of water when full. It was provided with a sliding cover, and a single hole in the center of this was found to admit an ample supply of air. A salmon of average size could lie at length in it easily, but one of the largest size could do so only when in a diagonal position. Six or eight salmon were commonly put into the box together, and this number sustained but little injury during the overland jour-

> ney of one mile. As soon as the box had received its complement of fish it was filled brimful of water and drawn to the pond, where it arrived in about twenty minutes. The dray was backed into the pond until the box floated, or nearly so, and the salmon turned out gently. Some of them swam off at once into deep water, but often they were sluggish, and lay for a long time in the edge of the water. A few died immediately, and others after a day or two. When the river-water with which the boxes were filled was cool and clear the salmon suffered much less than when it was warm and roily."

Once the salmon had been spawned by hand, and the eggs had developed to the point where they could be shipped, several packing methods were used. The first involved using trays made of iron wire cloth with wooden frames around the edges. Several layers of eggs were placed on each tray, each layer completely surrounded by spagnum-moss. Most often pieces of mosquito-netting were spread beneath and above each layer, for convience in unpacking. The trays were then placed on top of each other (the frames supported the weight), and into a box, which in turn was placed into a larger box. Saw-dust or some other non-conductor of heat was added to protect the contents from temperature extremes. The second method involved the use of cylindrical tin boxes, about five inches in depth and six inches in diameter. The eggs were again layered, each layer surrounded by moss. A piece of mosquito-netting fitted with brass rings also enclosed each layer of eggs. The brass rings were needed for easy removal of the eggs. Eggs destined for the Merrimack River program were shipped by steamer from Bucksport to Boston, Massachusetts or Portsmouth, New Hampshire and then transported by rail.

Author's Note

The reader should not falsely believe that Maine procured salmon eggs solely for the benefit of the Merrimack River restoration program. They did not! Penobscot River salmon eggs were in great demand throughout much of the United States, and in fact, were being shipped extensively. The Merrimack River program was just one small beneficiary of the Maine egg procurement effort.

Interestingly enough, there are some individuals who believe that the near extinction of the salmon population in the Penobscot River (middle 1900's), was directly related to the taking of the adult salmon for egg procurement — especially since the majority of the eggs were deposited in areas outside of the Penobscot River drainage.

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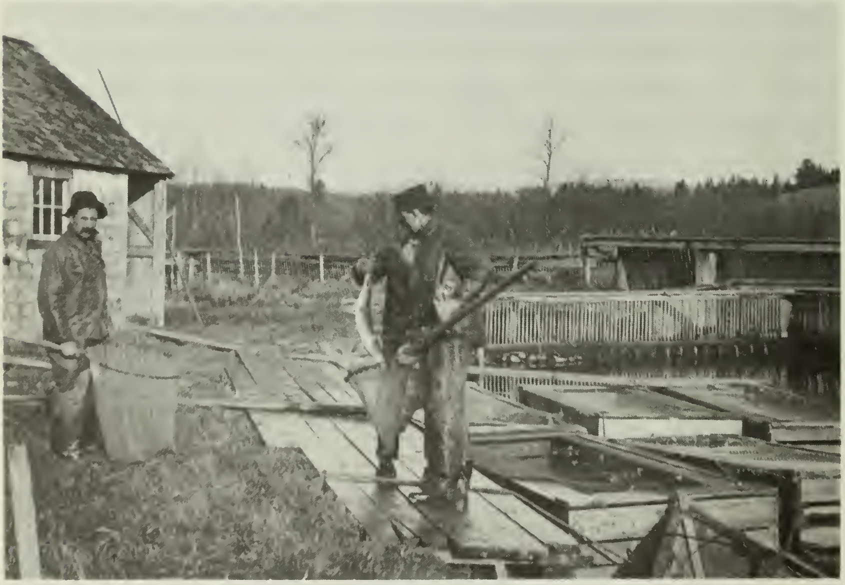

Figure 18. A hatchery-man obtains an adult salmon from the holding facility at Dead River (near Craig's Pond) during the 1890's.

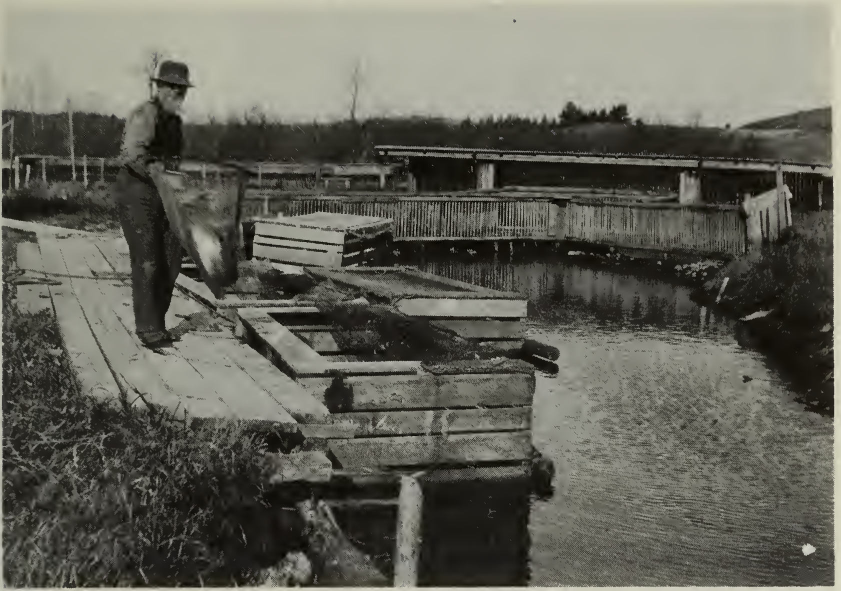

Figure 19. Another adult salmon is netted from the holding facility at Dead River in preparation for spawning. Circa 1895.

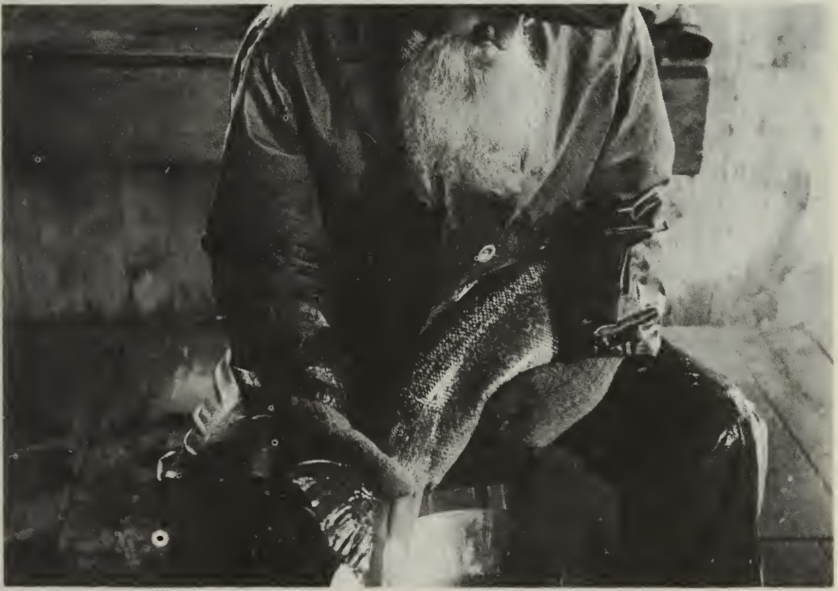

Figure 20. A female salmon is being spawned during the 1890's.

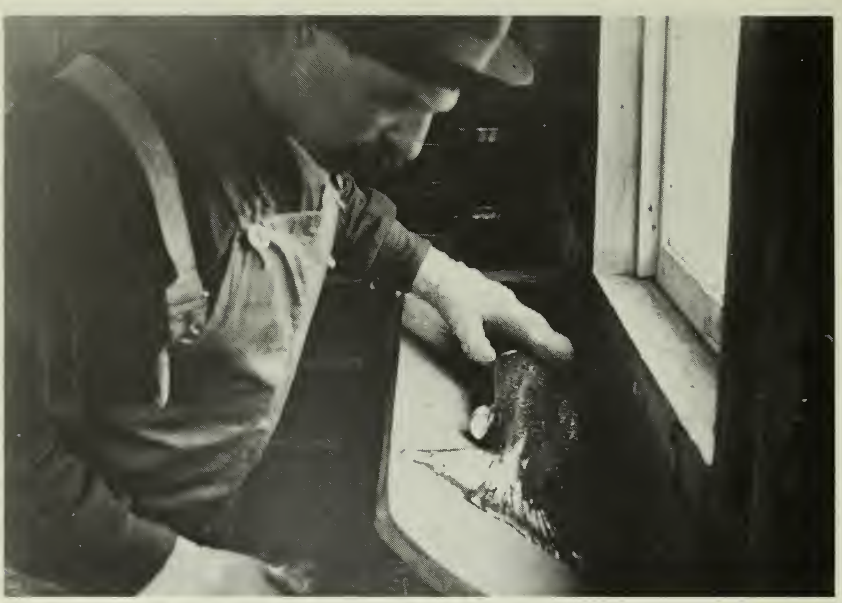

Figure 21. Records were vital to the program. Here, a hatchery-man is shown measuring an adult salmon during the spawning operation in the 1890's.

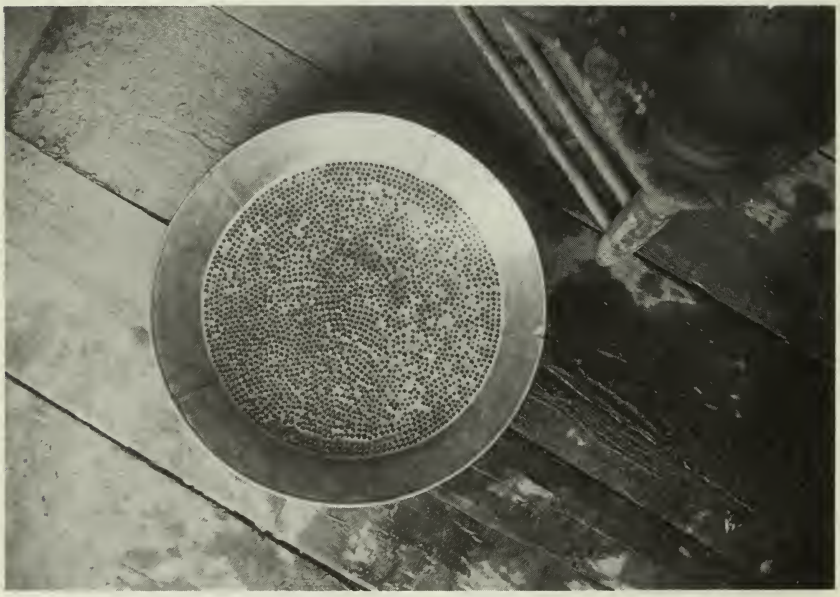

Figure 22. The salmon eggs have just been fertilized. Circa 1895.

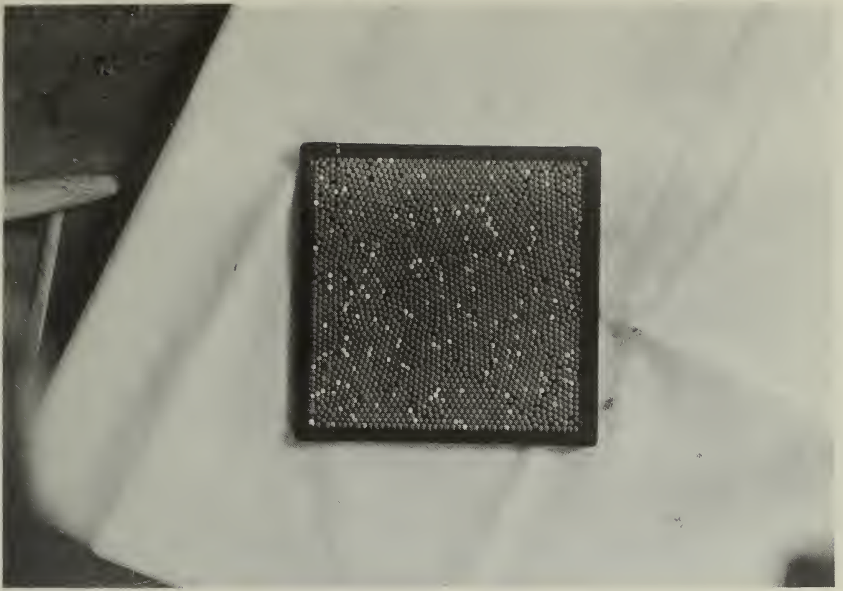

Figure 23. A tray of salmon eggs is shown shortly after fertilization. Those eggs that had turned white had died. Circa 1896.

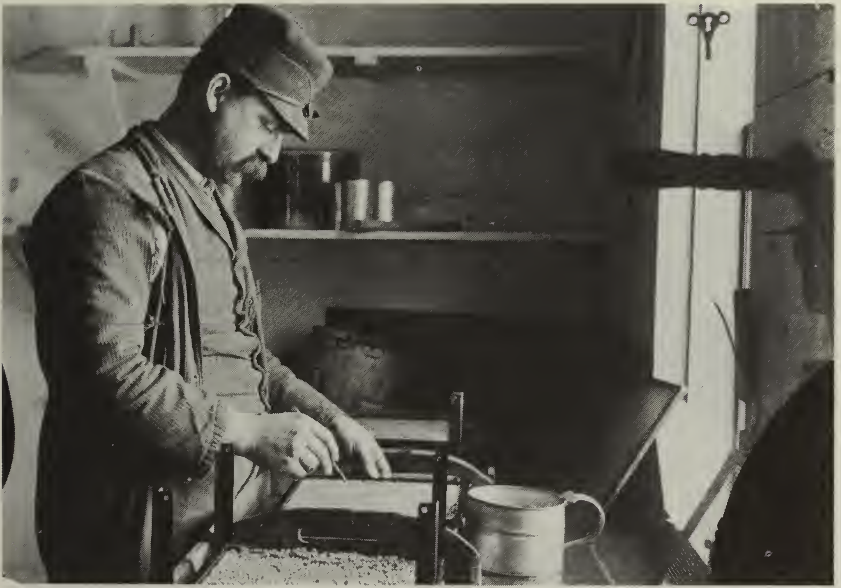

Figure 24. Charles E. Gibbs is shown removing the dead eggs from an egg tray during January of 1896.

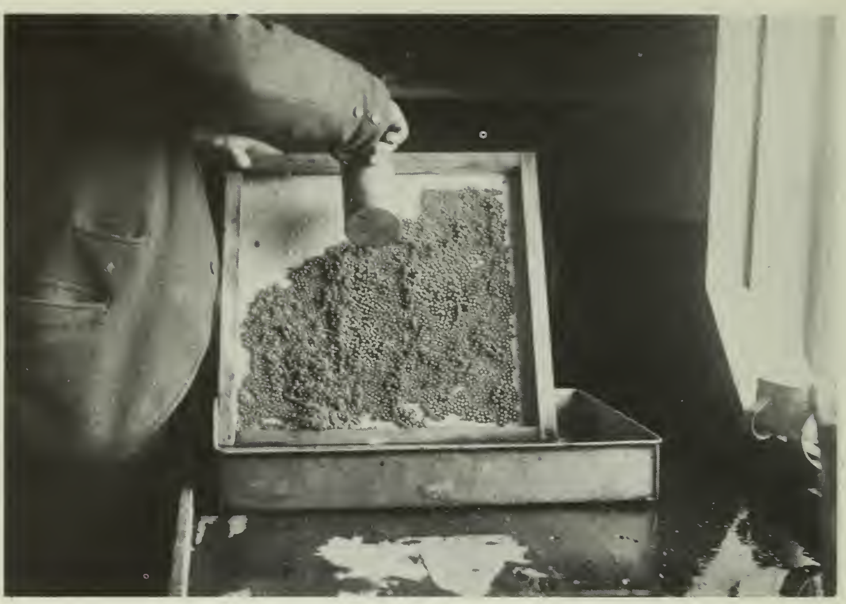

Figure 25. The salmon eggs must be removed from the tray in preparation for packing prior to shipment. Circa 1896.

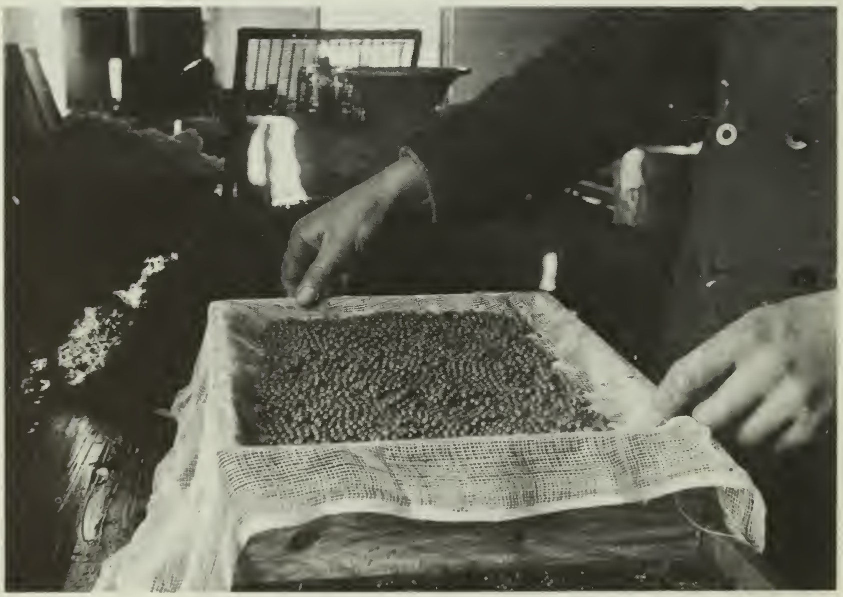

Figure 26. In this photo, circa 1895, the Atlantic salmon eggs are being placed into a shipping tray.

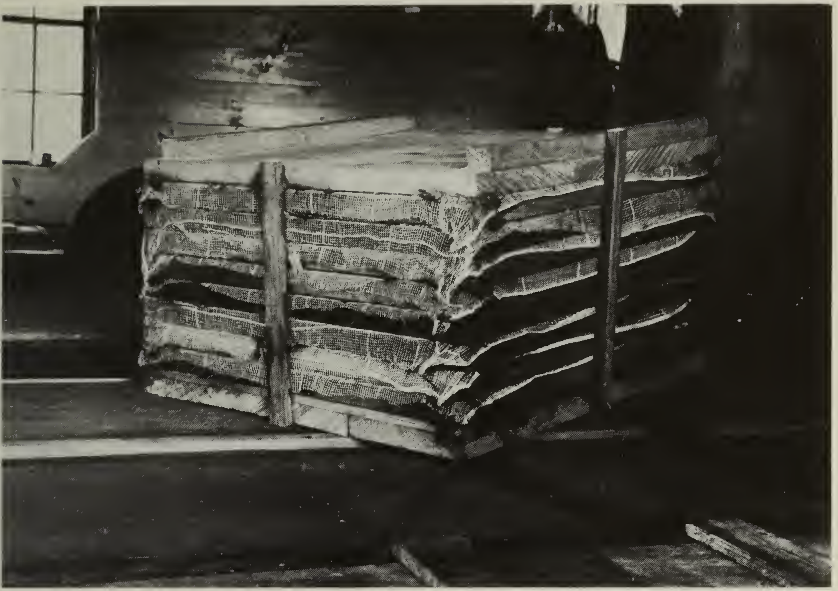

Figure 27. A stack of trays, each holding Atlantic salmon eggs, have been prepared for placement into a larger container. Circa 1895.

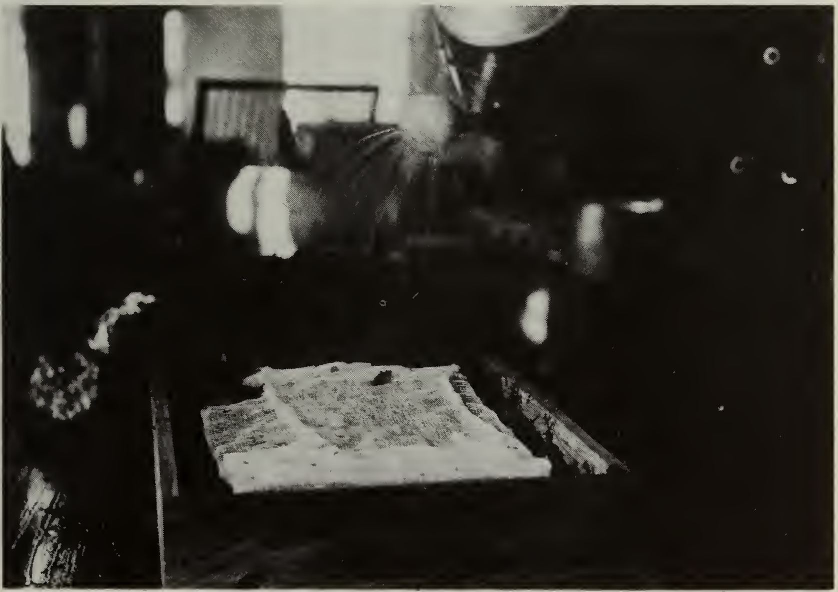

Figure 28. The salmon eggs are watered before being shipped. Circa 1896.

Figure 29. This 1896 photo shows a number of cases of salmon eggs ready for shipment.

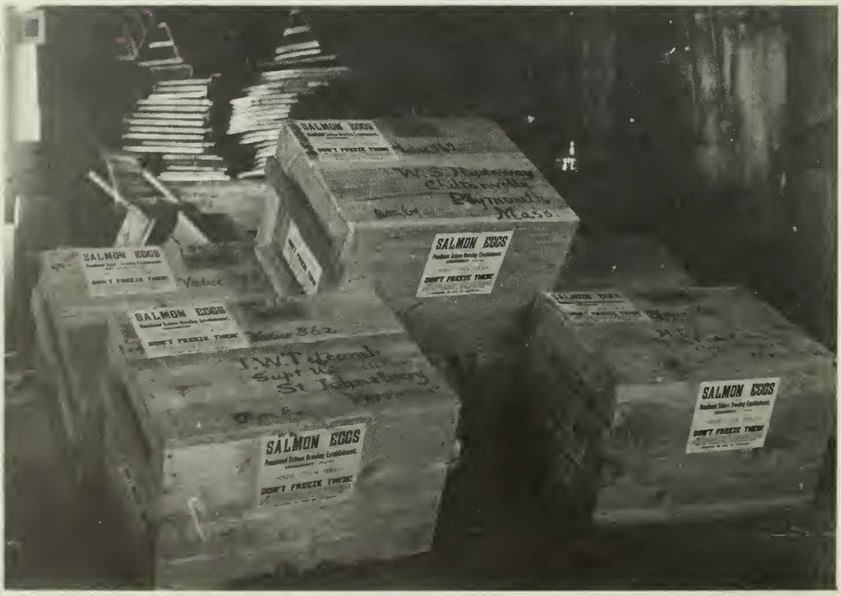

Figure 30. In January of 1896, these cases of salmon eggs were addressed and waiting for shipment. Note where several of the shipments are destined.

Chapter Four

Chapter Four:
A Summary And The Introduction Of An Exotic

"Our native salmon are doubtless the best fish for propagation with us."
New Hampshire Fish and Game Commission

When Maine entered the program in 1871, a stability relative to a continued egg supply was generated for the restoration program. This stability required a great deal of cooperation and proper timing on the part of many individuals. The number of salmon fry that were released into the Merrimack River from 1873 through 1876, attests to this spirit of cooperation. In 1873, 174,000 fry were released into the Pemigewasset River, none in 1874 (all fry in 1874 were released into the Connecticut River), 245,000 fry in 1875, and 400,000 fry in 1876. Included with the figures for 1875 and 1876 were 20,000 fry for the Contoocook River and 40,000 fry for the Nashua River, respectively.

These fry releases began to provide positive indications that success was not far off. In 1876, numerous letters from the public to the Fisheries Commissioners of New Hampshire, indicated that significant numbers of juvenile salmon were found throughout the Pemigewasset River. Undoubtedly, but undocumented, juvenile salmon would also have been plentiful in 1874, and 1875. This is somewhat substantiated by the fact that the New Hampshire Fish and Game Commission was, in 1876, urging the passage of an Act that would prohibit the catching and possessing of young salmon in the upper and middle portions of the Merrimack River.

It is interesting to note that even with the impending success of the restoration effort, the lack of adult fish returning to the river was a concern of the Fisheries Commissioners, and thus, prompted the New Hampshire Fish and Game Commission to make the following statement:[28]

> "When the enterprise was first started, we made our calculations as best we could, as to the time required to produce mature salmon in our rivers; but we were undoubtedly a little too fast, and did not make sufficient allowance in time to perfect the fishways over some of the highest dams. We also expected too many adult fish from a given number of young. We believe our rivers can be restocked, and every commissioner in New England, at least, says amen."

The Fish Commissioners had indeed been too hasty in expecting results. One could hardly have expected much to have resulted from the very minor fry-releases made prior to 1868, and those would have been the only fish that would have appeared as adults within the river up to 1872. Even the fry-releases made from 1869 through 1872, could not have been expected to produce adults back to the river — and they did not. It was not until 1877, due to the large fry-plant made four years previously, that adult salmon returned to the river.

During the 11-year period (1866 through 1876) prior to the return of adult salmon, nearly 1.3 million Atlantic salmon fry had been released into the Merrimack River, the fishways had undergone almost continual revision and by 1875 were considered to be in excellent working order. The American shad restoration program had caught fire, and chinook salmon eggs had been obtained from California.

Although the 11,255 shad harvested commercially at Lawrence in 1876, was a far cry from the 365,000 taken in the lower river in 1841, it nevertheless was a steadily increasing statistic; one that provided a great deal of encouragement to the state of Massachusetts. The rather intensive fishery for shad, encouraging on one hand, was on the other hand, of deep concern to those involved with the restoration of Atlantic salmon. It was vitally important that the commercial fishery be highly regulated when adult salmon returned.

A concern relative to excessive water temperatures in the Merrimack River and its headwaters was reported to have prompted the Fisheries Commissioners of Massachusetts and New Hampshire to experiment with the chinook salmon of the Sacramento River in California.[29] According to the records, these salmon were better able to withstand warmer water than the Atlantic salmon. During 1876 (also in 1878, 1879, and 1880), chinook salmon eggs were obtained from California through Professor Baird and the resultant fry were released into the Contoocook, Baker, and Pemigewasset Rivers. These practices never did provide positive results as evidenced by the following quote:[30]

> "The attempt to propagate California salmon has so far been a failure, and your commissioners do not propose to carry the experiment any farther. Several lots have been consigned to New Hampshire in previous years, but after hatching and depositing them in the rivers, nothing more has been seen of them; and this, so far as we can learn, has been the experience of all fish-culturalists on the Atlantic coast. Our native salmon are doubtless the best fish for propagation with us."

Although it might seem that very little was accomplished during the period (1866 through 1876), the only thing truly lacking was the returning adult salmon. The ground-work for the future had been laid. Much of what happened during this period is summarized in a significant and most interesting oration presented to the Fish and Game League of New Hampshire by Doctor Spalding (a Fisheries

Commissioner of New Hampshire) early in 1877. Dr. Spalding's ideas are presented in the next few pages, (the Atlantic salmon restoration effort often brought out the best in the public speakers of that period):[12]

> "The subject on which I have been invited to address you at this time is the restoration of sea-fish to the Merrimack River; and in what I shall say, I do not propose to discuss the natural history of migratory fish, or to dwell at length on fish culture as an art.
>
> It is only about twelve years since public attention in this country was directed to the restoration of salmon and trout to waters in which they were formerly abundant, but where from various causes they had become nearly or entirely extinct. The practical information which was possessed on this subject was confined to a few individuals, respecting two or three varieties of fish. Since that time a wonderful advance has been made in science and art as applied to fish-culture. The crude and limited experiments of two or three persons have been followed by a success so complete and remarkable, and of such manifest importance to the public, that many of the states in the Union, and the national government itself, have become actively engaged in the enterprise. Artificial breeding, then confined almost exclusively to the Salmonidae has been extended to a great variety of both fresh and salt water fish. It is no longer a question whether restocking the rivers of our state is feasible.
>
> The enterprise is not one of trifling moment, affecting only a few persons more distinguished for the virtue of patience than the love of profitable employment; it concerns an important industry which would give employment to a considerable number of persons; it would supply a large amount of wholesome and nutritious food at a more reasonable price than it can be obtained at the present time, and in better condition. It would give a new attraction for summer visitors and sportsmen, and add materially to the pecuniary resources of the state.
>
> The entire area of the state is 9,280 square miles, or

5,939,200 acres, of which the Merrimack basin contains 3,800 square miles, or 2,840,000 acres. Of this area, one million acres are covered with water. Considering the hard and sterile nature of a large part of the soil of New Hampshire, it would seem that any enterprise looking to the cultivation of this vast acreage of water ought to commend itself to the favor and patronage of the public.

There is tradition, believed to be authentic, that in the early settlement of the state, before impassable dams were built across the streams, fish were so abundant that the farmers living along their courses were accustomed to use shad and alewives on their land as manure. We will not believe that the lordly salmon was ever put to such an ignoble use. At a more recent date, we are told that young men, bound out to work as apprentices, had a clause inserted in their indentures to effect that they should not be required to eat salmon more than three days in a week. Some of us in these days would be glad to take as a luxury what was then considered a penance.

It may be said, that when the attempt to restock the river was begun, the best methods of doing the work were not understood as they are now; that great improvements in artificial breeding have been made; that the supply of ova and young fish was comparatively limited; that it takes several years to restock a large river; that the fishways early in use were unsuitable and imperfect; and that the pecuniary means at the disposal of the fish commissioners were small and insufficient. But the assertion that nothing has been accomplished is not quite true. Our commissioners have placed many hundred thousand salmon, ova, and young fish in the head waters of the river, and millions of shad have been hatched in the main stream. Much valuable experience has been gained, and the conditions necessary to success are now more completely complied with than ever before.

I think it will be allowed that the dam at Lawrence has been nearly a complete obstruction to the ascent of salmon. When the first fishway was built at Lawrence, the best methods of construction and location were not well understood. Material improvements and changes have since been made, and whatever justice there may have been in alleging that the pass was imperfect and useless, we in New Hampshire should remember that it was made after a model of our own choosing; that the Massachusetts commissioners were directed by their legislature to submit the work to the inspection of the New Hampshire commissioners, by whom it was approved and accepted. But this old pass has passed away, and a new one has taken its place. The legislature of Massachusetts appropriated the sum of four thousand dollars for this purpose, and the work was completed in the autumn of 1876.

On the 29th of last September the water was let into the fishway, in the presence of the commissioners of Massachusetts and New Hampshire. It required about seven minutes to pass from the entrance gate to the outlet, a distance of 228½ feet. The entire structure is made upon a new plan, designed by Mr. E. A. Brackett a) of Winchester, Mass., one of the commissioners of that state. The grade is one foot in fifteen, with a depth of two and one half feet, and the capacity for greater depth, if it should be found necessary. The width of the pass is twelve feet. The great advantage of the Brackett fishway is in the top hamper, which extends from the crest of the dam, fifteen feet, to the first bag, receiving the water from the river in a gentle flow, and in the successive bays extending to the outlet, holding the current and breaking the force of the descending water, so that when the pass is full there is no violent rush at any point.

Having made the way clear for the fish to ascend the river to their spawning grounds and to return to the ocean at their appointed season, and with a state breeding establishment properly equipped and supported, it is still essential to success that capture of

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a) E. A. Brackett designed a number of fishways in Massachusetts, and also provided a design for the fishway at Amoskeag Falls in Manchester. In 1873, he angered Charles G. Atkins, in a report regarding the fishways utilized in Maine. Atkins responded to Mr. Brackett in a letter which is presented in Appendix VIII. Whether or not the report to which Mr. Atkins refers deals with the design at the Essex dam is unknown.

> fish should be controlled by law, and that they be protected at certain seasons when they are unfit for market. Our fish laws need revision. Fish wardens should be appointed, invested with authority to arrest offenders against the statutes, and to see that proper penalties are enforced. The people of the state should be made to see that our lakes and rivers may become an important source of wealth, of subsistence to the people, and of income to the state. The farmers living along the borders of our inland waters should be convinced that the pools and rapids under their control can be made to yield a richer harvest than can be gathered from the hard acres of the adjoining land."

If we are to believe Dr. Spalding, then the necessary ground work had indeed been laid for a very eventful future. It appears that the problems associated with fish passage had been overcome, that the mechanics of obtaining salmon eggs and distributing the fry were refined, and that the potential problem of commercial fishing was being addressed. Success could only be around the corner!

Author's Note

The real stimulus for the introduction of spring chinook into the Merrimack River probably lies with Livingston Stone, rather than the belief that the water temperature in the river was too warm for the Atlantic salmon. When Livingston Stone accepted the position of Deputy Fish Commissioner in the California area in 1872, he immediately began working with the spring chinook. This fish was extremely plentiful, and survived in rivers having rather warm temperatures.

With this in mind, and the fact that rivers such as the Delaware, Susquehanna, and others on the eastern seaboard (New York State and southward) were devoid of salmon, the introduction of this species was quite logical to Livingston Stone. The introductions that occurred within the Merrimack River were probably a spin-off from this activity. The fact that Mr. Stone was a native of New Hampshire and well aquainted with the Atlantic salmon restoration effort and its rather meager egg supply, may also have been an important factor.

Chapter Five

Chapter Five:
Initial Success - 1877

"The return of mature salmon to the waters of the Merrimack this year commences a new era in the history of fish-culture in this country."

Elliott B. Hodge
Plymouth, New Hampshire

It is fitting to begin this chapter with the following quote from the New Hampshire Fish and Game Commission Report of 1878, referring to the previous years activities:[29]

> "Your commissioners submit their annual report with unusual pleasure. The labors of our predecessors have at last born fruit, and what has heretofore been a question of hope and faith has become a living and tangible reality. By means of the improvements in the fishways at Lawrence, Lowell, and Manchester, the salmon have returned to the upper waters of the Merrimack and have been seen in the Pemigewasset in large numbers."

A great many of the results were attributed to alterations, completed in 1876, on the fishway at Lawrence, which brought the entrance from its downriver position back to very near the base of the dam. This greatly increased the effectiveness of the entire facility. But, the large fry-release into the Pemigewasset River during 1873, easily and more directly accounted for the salmon run in 1877.

An important question exists regarding the size of the 1877 salmon run. A count of only 47 salmon at the Lawrence fishway leads to the conclusion that very few salmon returned. However, we must examine the method used for counting the fish at the fish passage facility.

No trapping facility existed within the fishway. Thus, any fish entering the facility could pass without stopping. Water was shut off from the structure twice a day up to the fifth of July, and once each day thereafter to ascertain what was in the fishway. Closing the fishway and counting all fish within the somewhat dewatered pass took about fifteen minutes. Interestingly, the actual closing of the facility (and the counting of the fish) represented only about 2% of the total fishway operating time. It is quite reasonable to conclude that many, possibly hundreds, of salmon could have passed upriver unnoticed in between sampling periods.

The question of how many salmon actually passed the fishway can be addressed in several ways. The Fisheries Commissioners themselves, in 1877, estimated that 1,128 salmon passed Lawrence. They reasoned that if 47 salmon were observed in two 15-minute counts per day, then the actual number of salmon passing would be represented by the multiplication of 47 by 24, hence the estimate of 1,128 salmon. The figure of 24 represented the number of 30-minute periods in 12 hours (it was assumed that salmon used the fishway only 12 hours of any particular day).

The same question was examined by Edward Baum of the Maine Atlantic Sea-Run Salmon Commission. Mr. Baum has been involved for a number of years with the capture of salmon in fish passage facilities on the lower Penobscot River. There, unlike the 1877 Lawrence fishway operation, all salmon that enter the fish passage facility are trapped. They cannot leave the fishway in either an up or downstream direction until deliberately released. In the opinion of Mr. Baum, if the operation on the lower Penobscot River was to be operated in the same manner as employed at Lawrence, possibly less than 5% of the salmon using the pass would be observed. If this 5% estimate was applied to the salmon observed in the Merrimack River in 1877, the actual number of fish passing the fishway may have been approximately 940.

Another method of estimating the size of the salmon run utilizes data obtained from a report prepared by Raymond Dow, relative to the salmon runs in the Penobscot River during the 1930's.[31] The report indicated that during 1932, 1933, and 1935, the salmon runs in the Penobscot River were principally generated through fry-release programs. The fry stocking programs were highly successful, with between 3.6 and 5.2 adults produced for each 1,000 fry released. Using a ratio of 3.7 adults per 1,000 fry (somewhat more conservative than the findings in Maine) provides an estimate of 644 adults for the Merrimack River in 1877.

I have chosen to remain conservative throughout this manuscript and have therefore employed the estimating procedure utilizing Dow's report, but with a 50% reduction (this reduction is approximate — the reader should refer to Appendix IV for a more detailed description). Thus, I estimate that about 350 salmon passed the Lawrence fishway in 1877.[a)]

The first salmon was counted in the fishway on May 31, and the last on July 30. During that 62-day period, salmon were counted during only 28 of the days. However, it was reported that a full run of salmon occurred during the month of October; commencing on October 11, and ending on the 30th.

The size of the salmon that entered the Merrimack River in 1877, was from six to nearly 20 pounds. It was reported that one in seven was about eight pounds, five in seven were in the 10 to 12

[a)] In many years there were Atlantic salmon runs within the fall months as well as the spring and summer. If no ladder counts were made, and in most cases none were, then I have not attempted to estimate their magnitude.

pound class, and one in seven was 15 pounds or larger. The heavy salmon run that occurred during October was composed of smaller fish, primarily in the six to eight pound range.

The New Hampshire Fish and Game Commissioners, in their report to the legislature, provided a description of an interesting and humorous event that occurred during the salmon run:[29]

> "Early in June we were notified by Mr. Brackett, of the Massachusetts Fish Commission, that salmon were passing the fishway at Lawrence.
>
> The dam at Lowell had recently been rebuilt, discarding the old fishway, but running the north end of the dam on to a gently sloping ledge in such a manner that it only needed to take off one flashboard to leave an easy passage, ten feet wide, with twelve or sixteen inches depth of water, over a fall of about the same height; and the fish found no difficulty in passing it, so that on the thirteenth of June we were notified by Mr. Kidder, the keeper of the gates and locks of the Amoskeag company at Manchester, that he had secured for us the first salmon seen at Amoskeag Falls for thirty years. We had requested Mr. Kidder to look out for the first fish that came up and let us know, and he had done so literally. The fish was a male, apparently of four years of age, two feet four inches in length, five and half inches in depth, and weighed eight pounds and five ounces.
>
> Mr. Kidder unintentionally transgressed the law in his anxiety to please the commissioners, but his fine was settled by his many friends in Manchester, and the salmon that followed were allowed to pass *free of toll.*"

Adult salmon first reached the Pemigewasset River around the first of July. J.R. Tomkinson of Holderness, New Hampshire was requested by Elliott Hodge, a fish warden at Plymouth, to watch for them at Livermore Falls. Tomkinson submitted a letter to Hodge later that summer, a portion of which follows:

> "The first of our seeing the salmon go up through the Livermore Falls was in the early part of July, 1877,

> when our attention was called by Mr. Hodge to see if we could see any salmon going up the falls. The first day we saw seven at four different times during the day, stopping only about ten to twenty minutes each time; this was the first day we began to look for them; we reported the same to every one that came along. Almost every day afterward, for about six or seven weeks, there were salmon seen. The largest number in one day (seen by my brother) was twenty. I myself saw five go up in forty-five minutes. We never lost much time in watching them, as we could not afford to lose any time for we have so much work on hand. I saw eleven on another day in about two hours. We never stopped a whole day to watch at one time, but state what we have seen. The above were seen abouth the twentieth of July.
>
> The largest one my brother saw was nearly three feet long, and he was within eight feet of it when he saw it."

Hodge, when submitting the above letter to the New Hampshire Fish and Game Commission, also added that adult salmon were seen all along the Pemigewasset River, to a point near a small dam in Woodstock, New Hampshire. Evidently the small dam in Woodstock prevented the fish from going further upriver. However, heavy rains during September washed out much of the dam and many of the salmon did proceed further up the river.

Not all of the salmon that entered the river were able to reach the spawning grounds in the headwaters. A number of individuals may have been harvested commercially, even before reaching the Lawrence fishway. It was reported that the shad run in the lower river was very poor (the number of fish that passed the fishway was very low), which was attributed to the persistent seining that occurred in the lower river. Undoubtedly, some adult salmon must also have been taken.

With reason the fishways at Lowell and Amoskeag could not be termed totally effective. In fact, the Amoskeag fishway, although passing (evidently) a goodly number of salmon, was considered inadequate and new plans, prepared by E.A. Brackett, were in the hands of E.A. Straw[a] of the Amoskeag Company. Because of extremely high water the plans were not implemented during 1877. There is always the possibility that some salmon entered the lower and mid-river tributaries. In spite of these factors, one must conclude that many salmon spawned and produced young within the river; notably the Pemigewasset.

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[a] E. A. Straw was a civil engineer for the Amoskeag Company who would some years later operate a steam yacht on the Merrimack River between Amoskeag Falls and Hooksett Falls.[8]

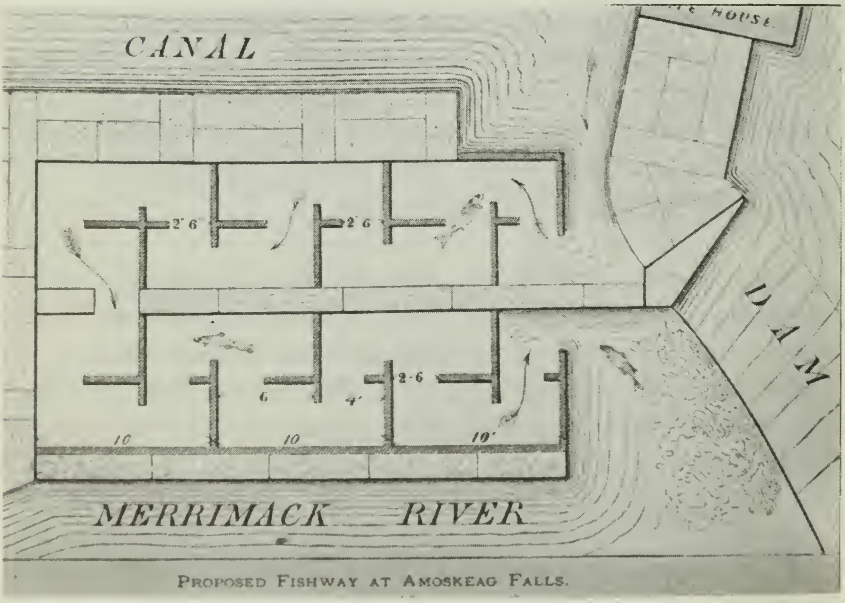

Figure 31. In 1877, E.A. Brackett prepared a new design for the fishway at Amoskeag Dam. It, however, was not implemented because of high water and unworkable conditions. Drawing courtesy of the New Hampshire Fish and Game Department.

If the adult salmon did not provide enough news, the abundance of young salmon, originating from previous fry releases did. They were reported to be so numerous that anglers could not keep them off their hooks. Many were supplied to the boarding houses along the river and its tributaries, either because of total ignorance or in willful violation of the law. In an attempt to minimize young salmon losses, the Fisheries Commissioners of New Hampshire had handbills, displaying the differences between brook trout and the salmon and calling attention to the existing law that protected the salmon, printed and distributed throughout the villages in the area. However, a great deal of the harvest (although no reference is made to the harvest of adult salmon in those areas, it must be assumed that they were also taken — an adult salmon would surely have been worth more than hundreds of young fish) was indeed a willful violation of the law as the following quote implies:[29]

> "We have among us, in every town and village, a class of worthless *ne'er-do-wells*, with few wants and no responsibilities, content if they can secure their rum and tobacco, who infest our forests and streams, killing every living thing they can, provided it will fetch a price in the market, no matter if it be a trout shedding its spawn or a woodcock hatching its eggs. Fines are useless as penalties against their offenses, and we have therefore reported to the commission in charge of the revision of the statutes an amended game-law in which imprisonment is allowed to be substituted for fines in such cases as may be needed to reach these cowardly poachers and keep them out of mischief for a season."

Most assuredly, any of the problems that occurred in 1877 were significantly overshadowed by the adult salmon!

Author's Note

Although the year 1877, was a highly successful one, there were suggestions that activities, namely the commercial shad fishery in the lower Merrimack River, were having an impact on the salmon restoration efforts. How severe the problem was is never really cited throughout any of the records (1870's through 1980's). It is however, alluded to continually.

The situation that developed on the Connecticut River is well documented and may very well represent to some degree the activities on the Merrimack. The regulations devised to protect the salmon were in most cases identical for both of the rivers.

The Fisheries Commissioners of Massachusetts were probably the first officials that called for strict regulation aimed at protecting the salmon resource as the restoration efforts developed. They were in fact, during the late 1860's and early 70's empowered by law to delay the construction of fish passage facilities on the Connecticut River (in Massachusetts), until they were satisfied that the legislature of Connecticut had adopted suitable measures that would allow free passage of fish.

It is noteworthy that the Massachusetts Fisheries Commissioners themselves, accepted some of the blame for problems that developed within the Connecticut River. And I quote:[29]

> "We regret to say that there appears to have been no action on the part of their (Connecticut) legislature looking to a restoration of our rights. The commissioners of this state, through the assistance of Seth Green, established an easy and certain method of increasing shad by artificial cultivation. By this and other means we, in connection with the commissioners of Connecticut, made shad more plenty than they had been for half a century. This appears to have been our ruin. It made fishing profitable. Hundreds of people on the lower part of the river rushed into it. The legislature, which had promised by its acts to restrict the pounds at the mouth of the river, repealed the laws regulating them. The fishermen clamored for an extension of time, and the state granted the right to fish until the twenty-fifth of June, at which time all migratory fish have entered the river. In addition to a large number of seines, an army of gill-nets is permitted to patrol the river, day and night. And last, not least, a law has been passed allowing the capture of all adult salmon, which gives them no chance to reach their spawning grounds when they return. It looks a good deal as if their fishermen owned, not only their seining-grounds, but the legislature also."

However, by the mid-1870's the southern New England states had united and established laws that protected salmon. These laws which entirely prohibited the capture of salmon within the rivers were extended to 1882, and in the case of Connecticut, until 1883. It was felt that by 1882 or 1883, the salmon restoration efforts on the two rivers would have progressed to the point that salmon fishing could be justified.

The laws directed at protecting the salmon were very difficult to enforce. Undoubtedly the commercial fishermen while fishing for shad still caught salmon (an indirect harvest). Some of the salmon that were harvested in this manner, may have been released unharmed; some probably died after being released; and some may have been cleverly concealed and taken ashore. The situation would definitely have been complex.

Although it is not known that what happened on the Connecticut River actually happened on the Merrimack, one can speculate that it did — but probably to a lesser extent. The problem would have been minor in the beginning, but would probably have escalated, as the restoration effort progressed and more shad and salmon were available.

●

MR. A. H. POWERS.

A.H. Powers was appointed the first superintendent of the newly constructed State Hatching-House at Livermore Falls near Plymouth, New Hampshire.

Chapter Six

Chapter Six:
A State Hatching-House

". . . we examined several sites for the proposed state hatching-house and ponds, to be constructed jointly by the states of Massachusetts and New Hampshire, and formed a preference for the springs at Livermore Falls in Holderness."

New Hampshire Fish and Game Commission

An event of great significance to the salmon restoration effort was initiated in 1874, and discussed during each of the two ensuing years. In January of 1874, at a meeting of the New England Commissioners of Fisheries in Boston, it was suggested that a joint hatching-house be established at or near the headwaters of the Connecticut or Merrimack Rivers. This hatching-house would be used to hatch many of the eggs for both salmon restoration efforts. In 1876, the Fisheries Commissioners of Massachusetts offered to join New Hampshire, and pay one half of the expenses of the erection and operation of a state hatching-house, to be utilized for salmon, shad, and trout. The only thing that was needed in order for the venture to begin was finding a suitable location.

It was during the summer of 1877, that a number of sites were investigated regarding the state hatching-house. The choice of the springs at Livermore Falls, in the vicinity of Holderness, was made during August. Shortly thereafter, a ten-year lease for nearly six acres of land was agreed upon with William Tomkinson. He was the owner and a loyal supporter of the salmon restoration effort.

By October, the state hatching-house was constructed. A two-inch iron pipe was brought into it from the springs, hatching-troughs provided, a dam built across the outlets to the springs, and excavation started for a series of storage ponds. At the same time the excavation of the holding ponds commenced, a four-inch pipe from a flume that was in operation on the property, supplied by river water, was brought to the partially constructed ponds. This water was to be utilized if the spring water, which had a uniform temperature of 47 degrees, proved to be unsuitable.

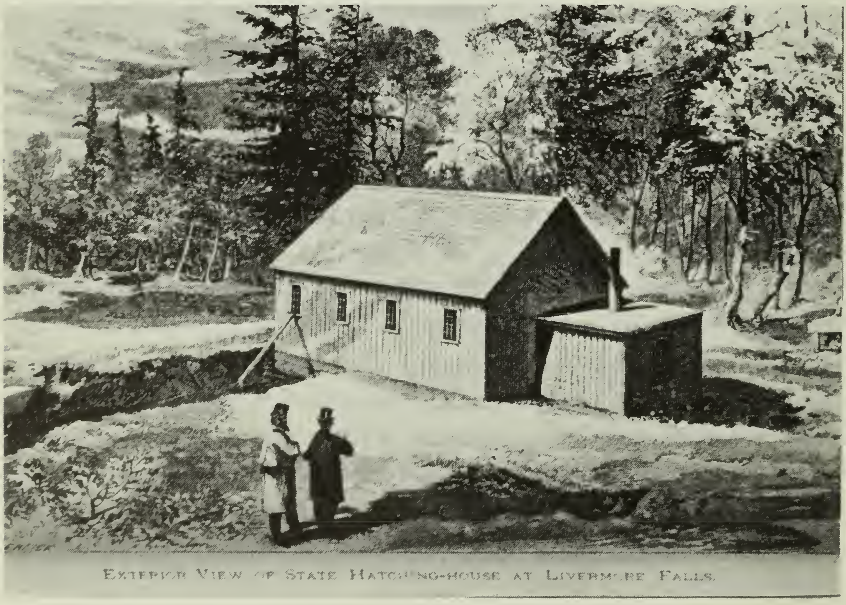
Exterior View of State Hatching-House at Livermore Falls.

Figure 32. Artist's drawing of the state hatching-house at Livermore Falls in late 1877. Picture courtesy of the New Hampshire Fish and Game Department.

The fisheries commissioners drew up plans to capture adult salmon in 1878, at Livermore Falls, then transport the fish to the holding ponds and artificially spawn the adults when they had matured. A.H. Powers, a Fisheries Commissioner from New Hampshire, was given the responsibility of running the facility. He was to be aided by Robert R. Holmes of Wareham, Massachusetts, an employee of the Massachusetts Fish Commission.

The state hatching-house was barely constructed when the first shipment of salmon eggs arrived. They were not Atlantic salmon eggs however, but eggs from the chinook salmon of the Sacramento River in California. It is interesting to note that of the 100,000 eggs shipped to the Livermore Falls facility, only 4½% were dead on arrival and just 4% of the remaining eggs failed to hatch. The fry that resulted from these eggs were to be released into the Baker, Pemigewasset, and Contoocook Rivers during 1878.

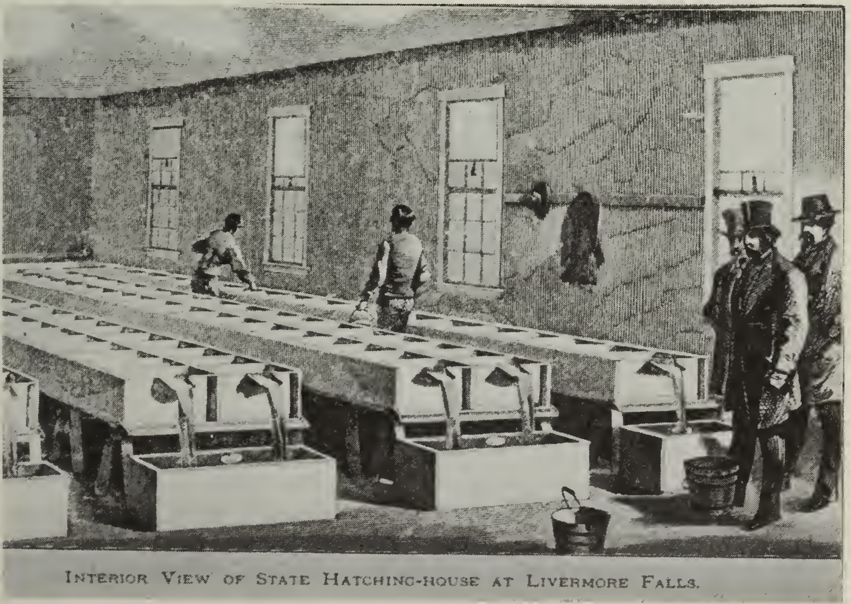
INTERIOR VIEW OF STATE HATCHING-HOUSE AT LIVERMORE FALLS.

Figure 33. Artist's drawing of the interior of the state hatching-house. Picture courtesy of the New Hampshire Fish and Game Department.

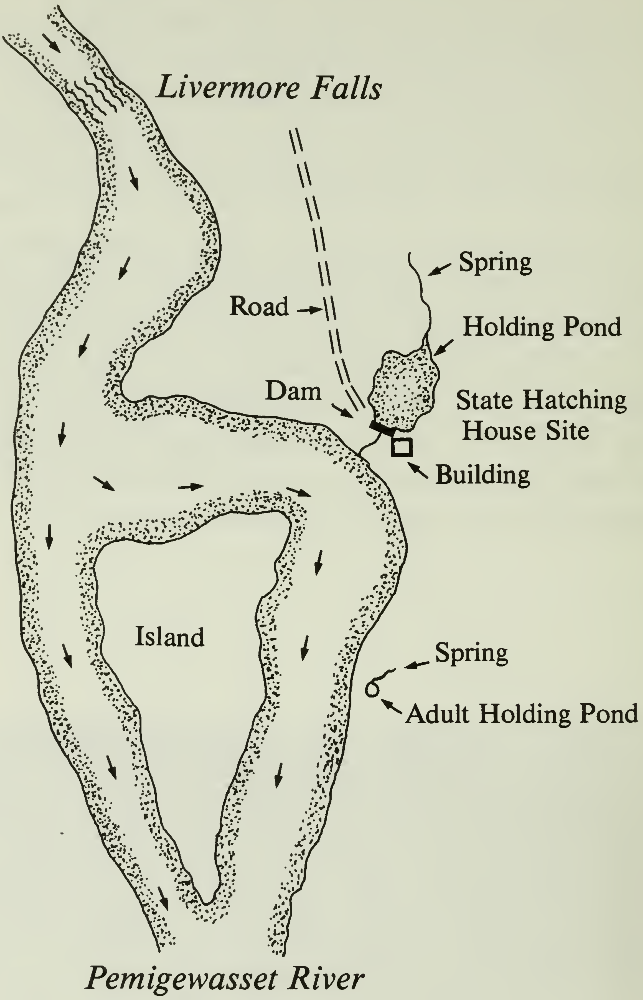

Figure 34. In August of 1979, the location (depicted in the drawing above) of the state hatching-house was found. As the accompanying photographs show, the area has changed considerably. An area with fields interspersed with timbered areas is now fully forested. However, the spring still runs strongly and remnants of the dam, piping, building, and the holding pools still exist. The holding pond, only a sizeable depression now, located downstream from the hatchery is believed to have been utilized for holding salmon that would be trapped in that location. Salmon could then have been transported to the principal holding facility at the hatchery when time permitted.

Atlantic salmon eggs were not available during 1877, which was also the case the previous year. Thus, no Atlantic salmon fry had been released into the Merrimack River during 1877, and none would be available for release the next year. The Atlantic salmon egg procurement operations of the United States Fish and Fisheries Commission at Bucksport on the Penobscot River, had not been able to obtain salmon eggs for the restoration effort. However, the salmon run in the Penobscot River was increasing and thus, the outlook for obtaining eggs in the future looked optimistic.

At its close, 1877 had been a highly successful period. A sizeable salmon run had occurred. Salmon had reached the headwaters of the Merrimack River and many supposedly had spawned. In addition, the state hatching-house at Livermore Falls had been constructed, and was successfully operating even though not with Atlantic salmon eggs.

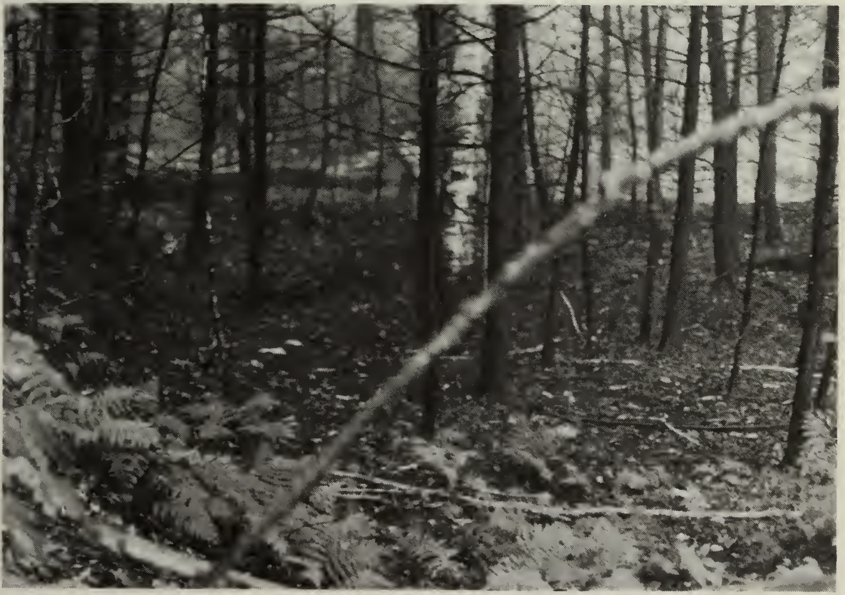

Figure 35. The remains of the foundation of the hatching-house are now completely forested as this 1979 picture shows.

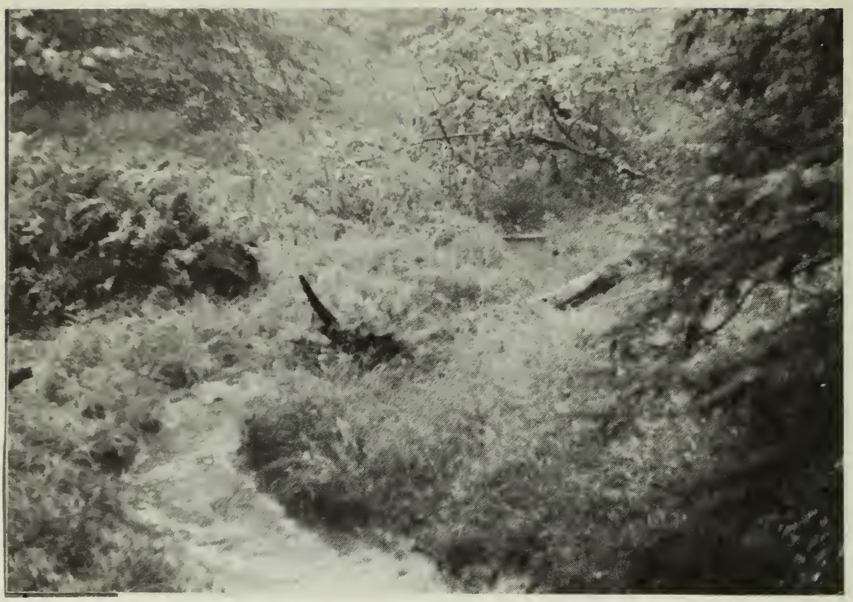

Figure 36. The spring that once fed the hatching-house and pond still runs quite strong and is estimated as now having a volume of nearly 70 gallons per minute.

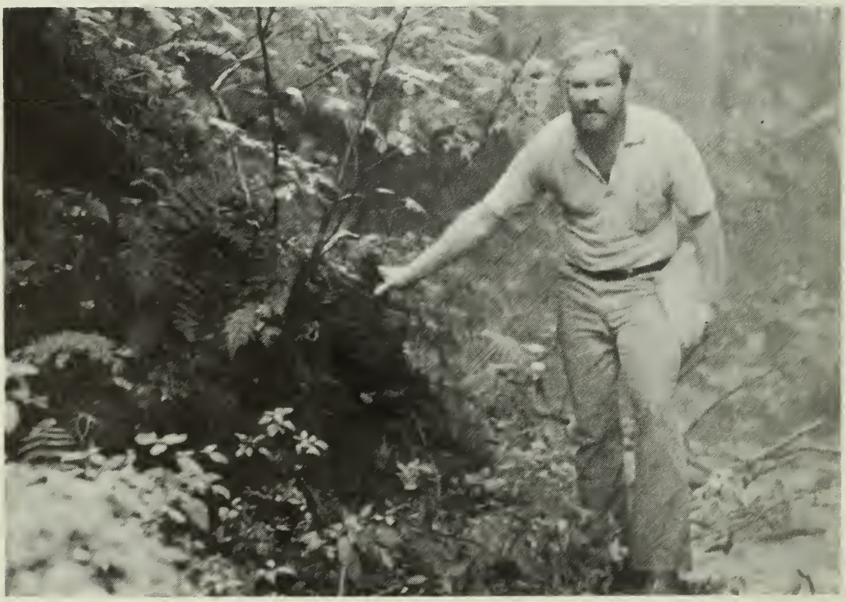

Figure 37. A portion of the piping and valve works at the hatching-house site still remains, as indicated by the author.

Author's Note

The importance of the state hatching-house to the restoration effort was of significant magnitude and that, coupled with the fact that plans were developed to trap adult salmon within the Pemigewasset River (beginning in 1878), placed even more emphasis on the facility. Utilizing a facility within the watershed, as well as the spawn from fish that survived to return, were two ingredients that had a bearing on the successfulness of the overall effort. Whether or not the Fisheries Commissioners realized the importance of the salmon that returned to the river is not known. However, it is likely that they did expect to achieve better results with "Merrimack River salmon" — just as we, today, expect to achieve our best restoration results with fish that have returned to the river.

The location of the state hatching-house however, might be puzzeling to some. One might have expected to capture more returning adult salmon closer to the mouth of the Merrimack River, resulting in more eggs for the program. A state hatching-house, if located near the mouth of the river, could have been filled with eggs from salmon that had returned to the river, as well as eggs from the procurement operations in Maine. The resultant fry could then have been transported by rail to the Plymouth area and released into the Pemigewasset River. Although logistics of this type of operation would have been a little more difficult, it would have been easily within the grasp of the Fisheries Commissioners, and would have resulted in more fry being released into the river.

The restoration of Atlantic salmon to the Merrimack River today somewhat addresses this same issue. Salmon will be trapped within the lower Merrimack River and transported to a hatchery (in most cases). Fry resulting from this operation will be transported to the headwaters and released.

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Chapter Seven

Chapter Seven:
Adult Salmon Trapped And Eggs Taken

"Since last Saturday, eight large salmon have lain in the Pemigewasset, near the mouth of Dickerman Brook. They would measure from two to four feet in length. Their presence created quite an excitement, and hundreds have been to see them."
The Bristol Enterprise, August 9, 1879

"The large salmon still remain in the Pemigewasset just below the bridge. Last Sunday they were visited by 156 persons."
The Bristol Enterprise, August 16, 1879

By 1878, the restoration effort had gained valuable experience and with the dramatic success of the previous year, achieved broad public support. The restoration effort had expanded and so had the duties of the Fisheries Commissioners. Eggs from such species as the landlocked salmon, the lake trout, and the brook trout were being hatched and the young deposited far and wide. Fish culture was becoming vitally important to the New England states, especially New Hampshire. It was also about this time that the New Hampshire Fish and Game Commission began to devote some of their energies to the wildlife of the state; the deer, the woodcock, etc. The complexities of the times were developing as quickly as the Atlantic salmon restoration effort.

During January of 1878, 100,000 chinook salmon fry were released into the Merrimack River; 60,000 in the Pemigewasset River near the state hatching-house, 20,000 in the Contoocook River, and 20,000 in the Baker River. No Atlantic salmon fry were released into the Merrimack River; the only fry of this species that existed in the river originated from natural reproduction that occurred the previous fall.

The stocking of fry was no easy or comfortable task. Most of the early releases occurred during the winter; December and January. As the restoration effort progressed, the fry would be held at the hatching-house longer and released during the spring when conditions were more tolerable — for fish and man. Those of us involved with the Atlantic salmon program today can appreciate the efforts of 100 years ago, and can be thankful we are not still in the horse and wagon days. The following quote rather well represents the early fry stocking procedures:[29]

> "The fry were taken from the hatching-house on December 11, from water at 45°[a] This was a cold windy day. On the way to the depot the covers to the cans were frozen on. The train was three quarters of an hour late, owing to some mishap, and as it was impossible to remove the covers, we kept the cans in constant motion by shaking. The covers were thawed off as soon as possible after getting on the cars, and the water, which was full of anchor ice, was found to be 32°, but the salmon were all alive, which was quite a suprise to us. The water steadily rose in temperature until it reached about 38°, varying from 37° to 39° in different cans. At Plymouth the cans were placed in open wagons, and carried about three miles, to the Pemigewasset River. It took an hour or more to complete the journey. When we arrived at the river, the can covers were frozen on as before, and we could not move them till we obtained hot water from a house near by. When they were removed, we found the entire inside of each can and

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a) This was not the state hatching-house at Livermore Falls, but refers to the hatching-house at Meredith, New Hampshire. The time period was 1876 — one year before the state hatching-house was constructed.

> cover coated with ice about a quarter of an inch thick, so that it would seem impossible for air to enter the cans, but yet all salmon appeared to be in good condition. Being very badly chilled, we omitted to test the temperature of the water, concluding that the water in the river was no colder than that in the cans; so we cut a hole through the ice and poured in the salmon. The change had no apparent effect upon them."

By the end of July 1878, three-inch long chinook salmon were described as extremely plentiful in the Pemigewasset River. Atlantic salmon fingerlings, derived from the 1876 fry-release, were also so numerous during July and August that it was reported to be impossible to fish for trout without hooking the salmon.[32]

Interestingly, these salmon, averaging nearly seven inches in length, began to disappear during late August. This may have been, unknowingly, the documentation of the period of fall downstream movement of the young salmon in preparation for entry into the sea either during the winter or the following spring.

The adult salmon run that occurred during 1878, was rather disappointing, compared to the previous year's results. Only 17 fish were counted at the Lawrence fishway. The first salmon was observed in the fishway on June 9th and the last counted on August 13th. The run was primarily composed of either fairly large or rather small fish, which would have been expected, since the run was generated through the fry releases of 1873 and 1875 (no fry had been released during 1874). The small size of the run, estimated today at about 80 passing the fishway, related directly to the lack of a fry-plant in 1874. It is interesting to note that more salmon were observed at the Amoskeag fishway than had been counted at Lawrence.[32]

During the month of July, the Amoskeag fishway, which was to be removed and reconstructed because of a new design of the previous year, was completely revamped during a period of three weeks. The new fishway now, was constructed with an entirely different design, however.

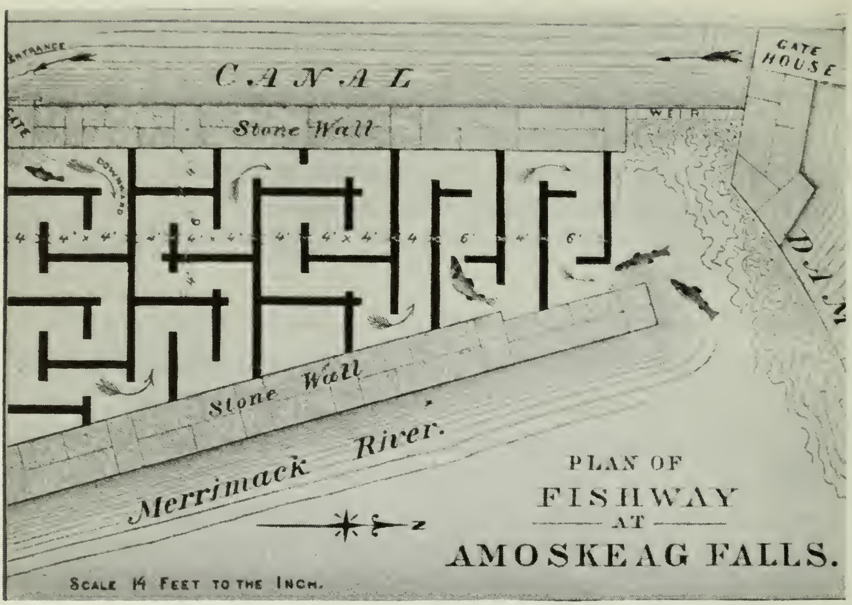

Figure 38. **The design utilized in rebuilding the fishway at Amoskeag Falls during July of 1878, was considerably different than that projected for the previous year. Drawing, courtesy of the New Hampshire Fish and Game Department.**

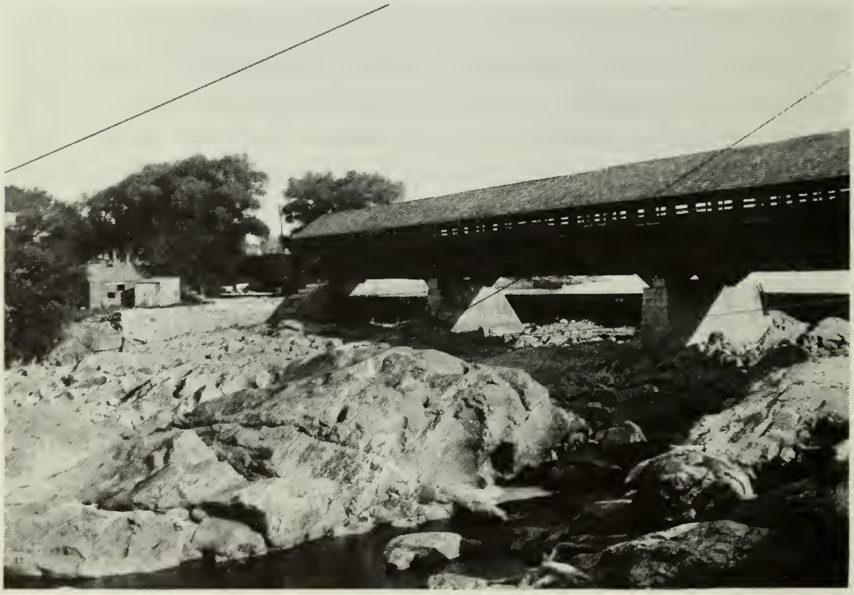

Figure 39. **The fishway, which cannot be seen, is on the left side of the river near the bridge. Note the extreme low flows — a great deal of the water may have been diverted from the dam to a point below this area, however. Although the picture was taken during the 1890's, it probably represents the appearance of the area in the late 1870's.**

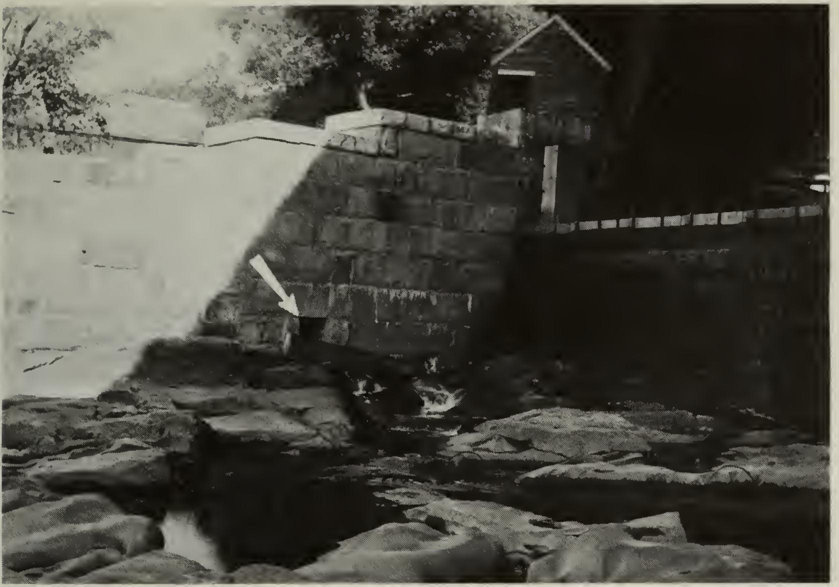

Figure 40. The entrance to the Amoskeag fishway (see the arrow in the photograph) was quite small and would have been totally submerged during the periods of high water. Circa 1890's.

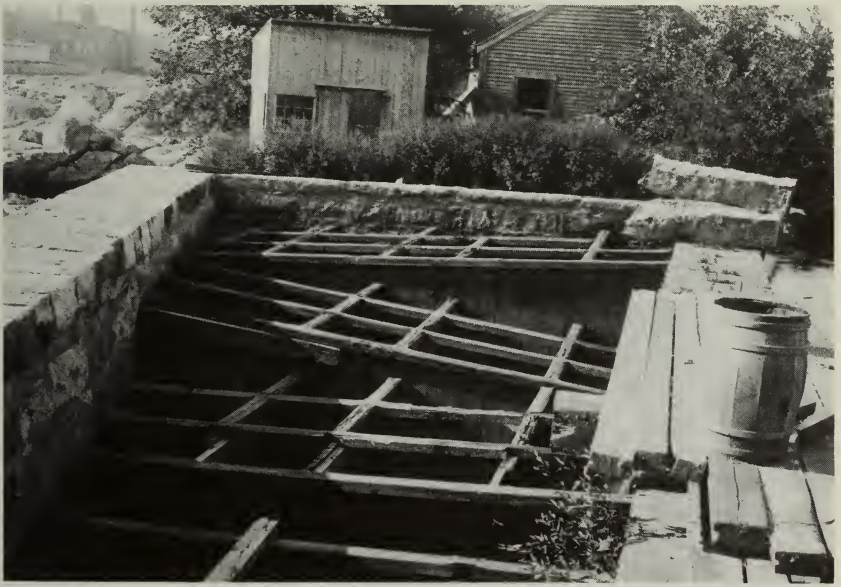

Figure 41. The inside of the Amoskeag fishway is depicted here. The river is flowing from the bottom right to the top left. The water on the extreme right is a portion of a canal system. Interestingly the fish that utilized the fishway entered the canal before actually passing the dam. Circa 1890's.

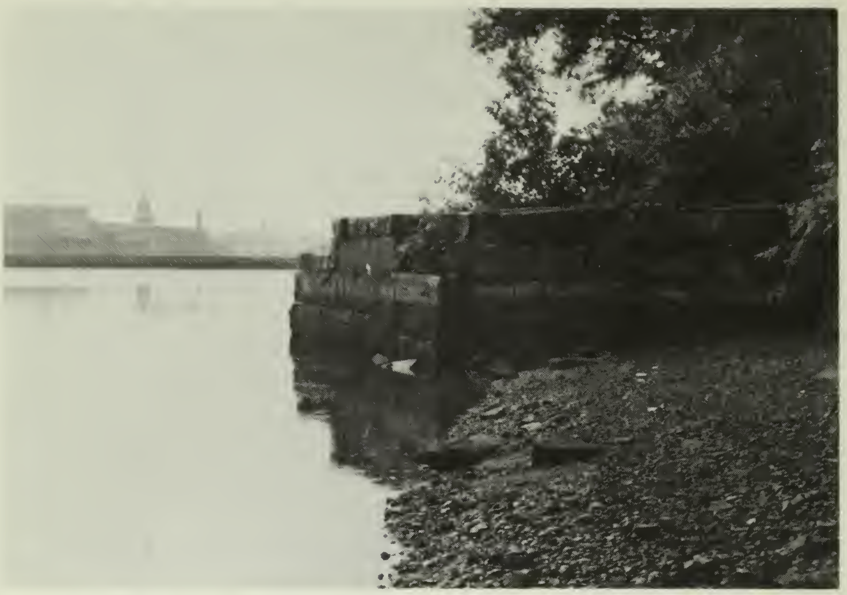

Figure 42. This 1980 photo depicts the upstream portion of the old fishway at the Amoskeag dam. The dam was located upstream from today's dam. Note the steeple in this photo and in the previous one.

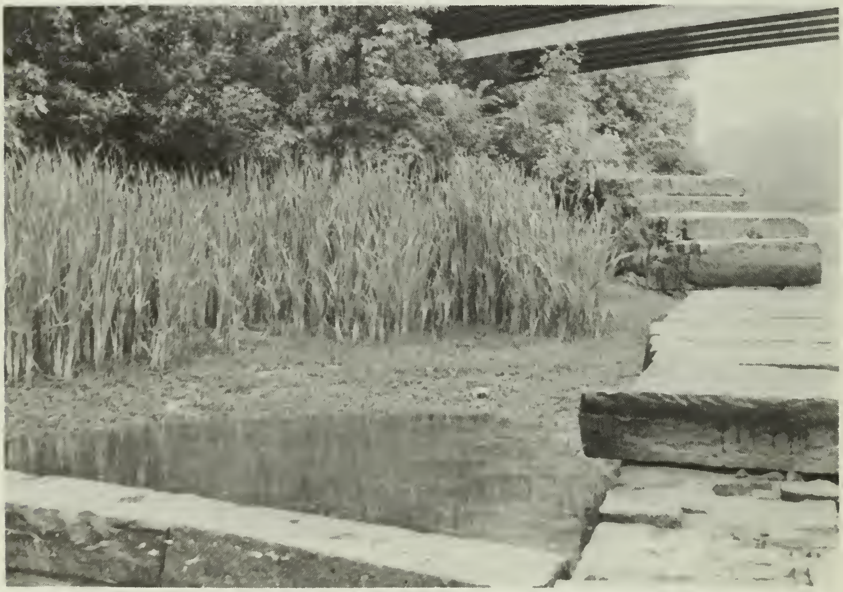

Figure 43. The interior of the fishway in 1980 does not resemble the earlier structure at all. It is now filled in and cattails are thriving.

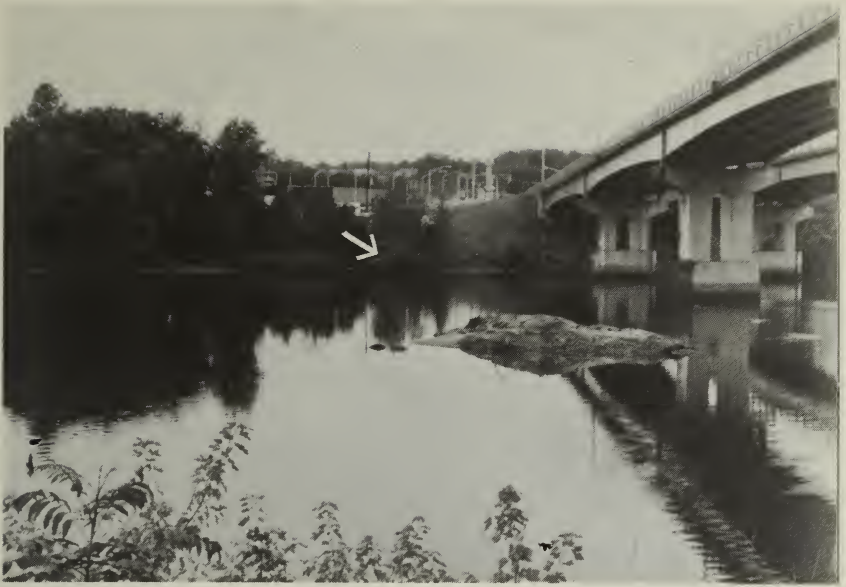

Figure 44. The remains of the Amoskeag fishway (1980) can be readily seen from the east bank of the Merrimack River. The rocky outcropping in the river once served as a portion of the foundation for the covered bridge.

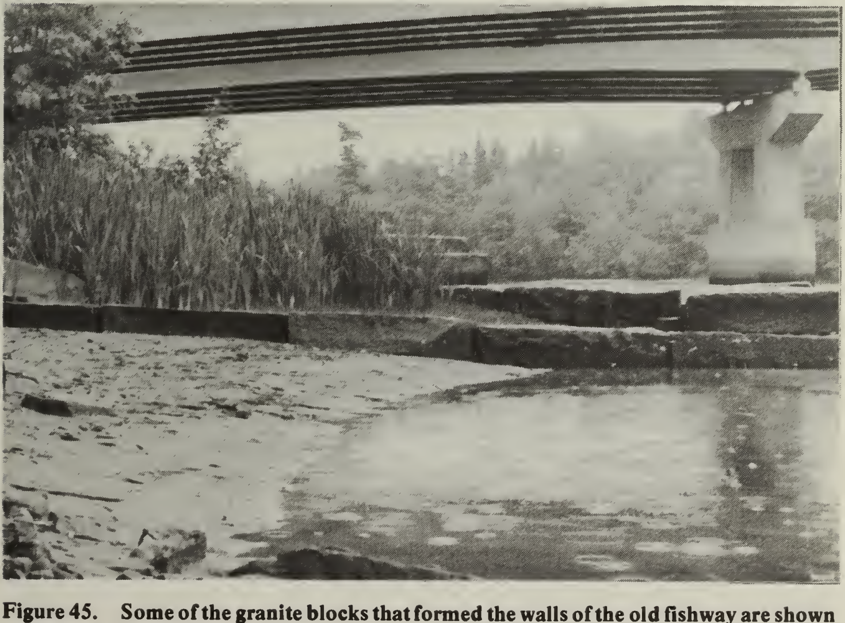

Figure 45. Some of the granite blocks that formed the walls of the old fishway are shown in this 1980 photo.

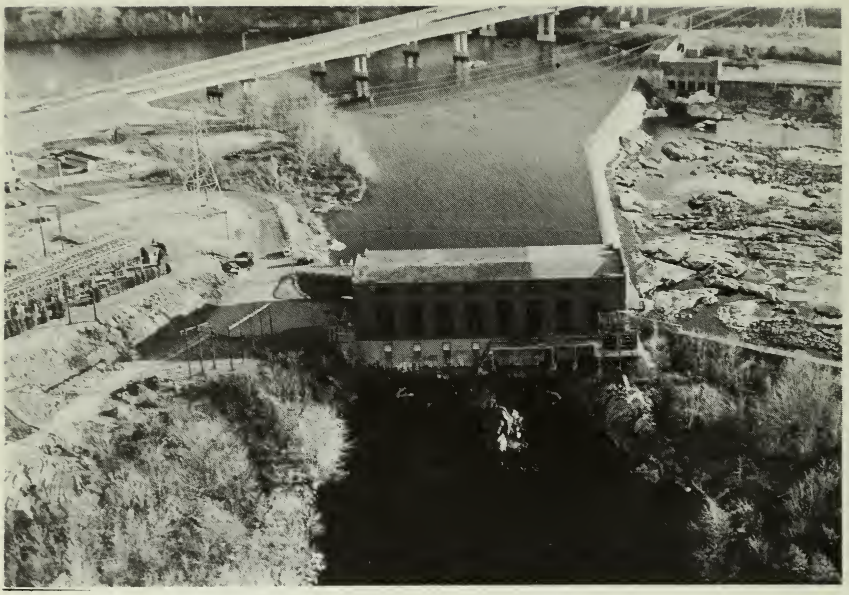

Figure 46. **This aerial photo, courtesy of Wayne Nelson of the Public Service Company of New Hampshire, shows the complexity associated with the Amoskeag dam today.**

The greatest disappointment of the 1878 season was the inability of the Fisheries Commissioners to trap a significant number of adult salmon at Livermore Falls. The nets that had been positioned in the Pemigewasset River were out of the water more than they were in, due to high water. However, 11 salmon were secured; the first being caught on June 22, and the last on October 23. Eight of the fish were males which were caught before the three females. No eggs were obtained from the females since they did not survive more than a few days. Some salmon however, reported throughout the Pemigewasset River, are believed to have spawned naturally in limited numbers.

The year 1878 proved to be the third in succession in which no Atlantic salmon eggs were available from the egg procurement operation on the Penobscot River. Thus, the Fisheries Commissioners had to rely on natural reproduction for the production of fry.

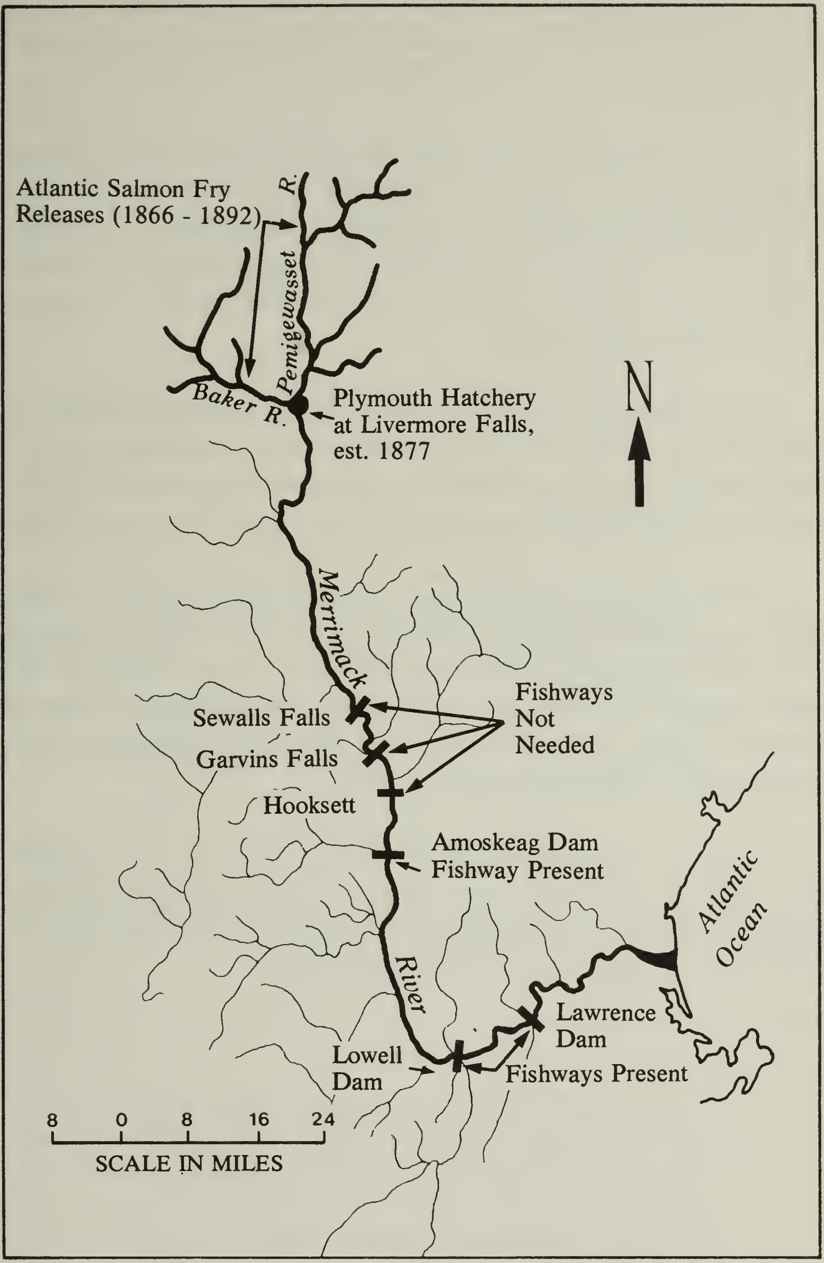

Figure 47. The Atlantic salmon restoration effort, beginning in early 1878, was based entirely out of the state hatching-house. This drawing represents the important features of the program in 1878.

The only salmon released into the Merrimack River during 1879 were chinook salmon. A total of 330,000 fry of this species was released into the Pemigewasset River.

The Merrimack River again experienced a run of salmon, generated primarily from the fry-release made in 1875. The first adult salmon of the season was counted at the fishway in Lawrence on June 2, and the last fish on October 9. Although only 29 fish were counted at the structure, I estimate that approximately 350 salmon actually passed the facility.

The weights of the salmon were similar to those recorded in prior years, ranging from six to twenty pounds. In the fall of 1879 a very large individual, weighing 28 pounds, was reported to have been found dead within the Pemigewasset River, above Livermore Falls.

The Fisheries Commissioners again attempted to trap adult salmon just below Livermore Falls, and were successful in obtaining 22 salmon during the period of June 13 through October 29. Interestingly, all successful trapping occurred during the hours of darkness or prior to 6:30 A.M. This was to be the general rule throughout the entire restoration effort.

Of the 22 fish captured at Livermore Falls, 13 were females from which 100,000 eggs were artificially taken during the last two weeks of October. This prompted Powers, the man responsible for the state hatching-house, to proudly remark:[33]

> "This is the first time, in this country, at least, that any considerable quantity of eggs has been taken from mature salmon caught from a depleted river artificially restocked. The result cannot fail to be highly gratifying to those who have, or have had, the matter in charge, and had to a certainty, demonstrated that the faith of the few, who argued that the rivers could be restocked to advantage, was well founded. Those who have believed it impossible must now be convinced that it is not only possible, but quite practicable."

The ability to keep the adult salmon alive and in good condition once they had been captured at Livermore Falls, was of the utmost importance to the program and would continue to be so. This success was the result of various improvements made at the state hatching-house during the summer, and I quote:[33]

> "Some improvements have been made in the storage pond in the way of excavations, making it larger and certain parts of it deeper.
>
> A tank, seven by twenty feet, has been placed at the inlet of the four-inch flow-pipe, covered on the bottom with gravel six inches deep, for the double purpose of receiving the salmon when first taken from the river, and attracting them there when ready to spawn. It worked admirably for both purposes. The river-water constantly running into this tank kept the temperature very nearly the same as that of the river, so the fish were allowed to rest before being placed into the cold pond-water; and during the night they could, if they chose, go back and forth from the river-water to the pond-water, and thus, the sudden change of temperature was avoided. This, with the improvement in carrying them from the pound to the pond, has prevented the growth of fungus, and they have been perfectly healthy at all times."

The year 1879 must have also been quite prosperous in Maine to the good fortune of the Merrimack River effort! The Bucksport salmon egg procurement program on the Penobscot River had resumed, and the Fisheries Commissioners from Massachusetts and New Hampshire were able to obtain 50,000 eggs. These, combined with the 100,000 eggs obtained from the Merrimack River salmon, meant that nearly 150,000 fry would be available for planting in 1880. One can also assume that a significant number of fry was produced by natural reproduction, because adult salmon were observed throughout the Pemigewasset River, most notably downstream from the state hatching-house in the fall.

The years, 1878 through 1879, were productive for the small restoration program. Two significant events occurred; adult salmon were trapped at Livermore Falls, and eggs were taken artificially.

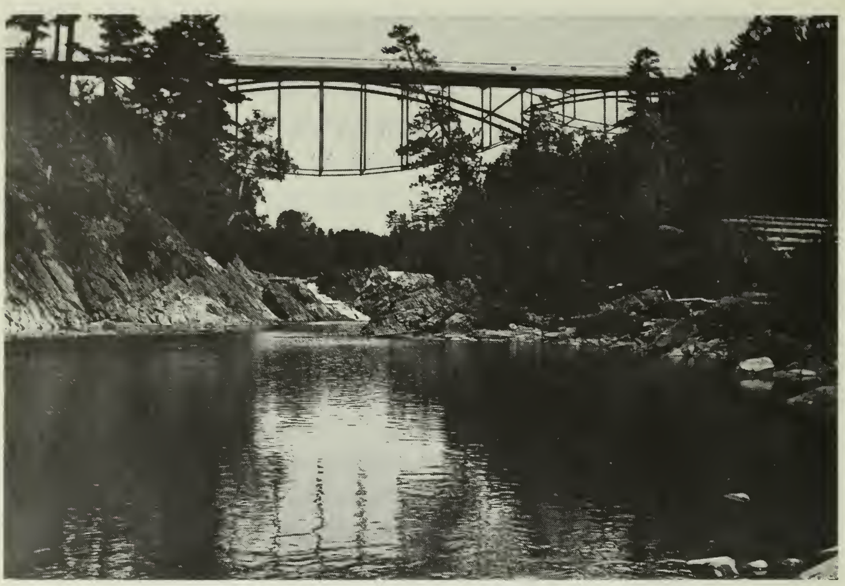

Figure 48. The bridge across the Pemigewasset River just below Livermore Falls and large pool below the falls are shown here. Many salmon probably rested in this pool during their journey upriver into the headwater areas. Circa 1895.

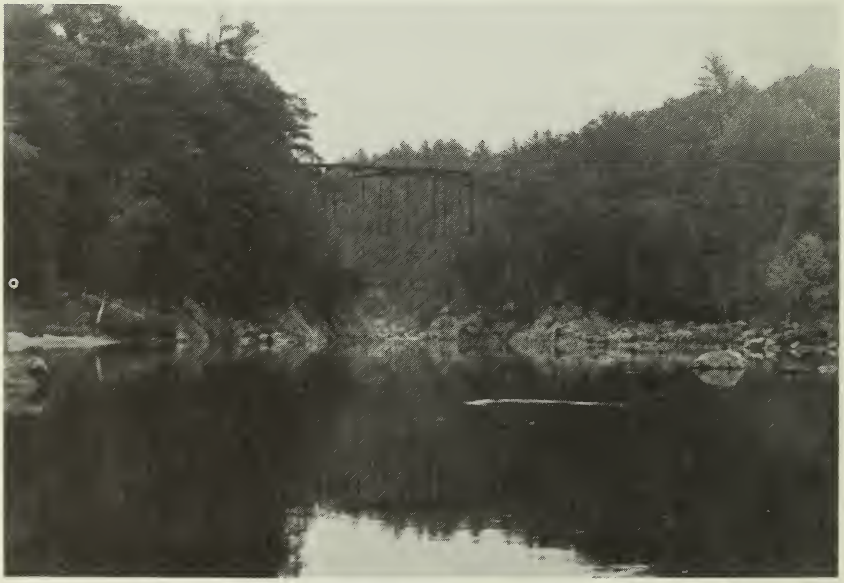

Figure 49. This current photo (1980) shows the same area as that in the previous picture. Note the remains of the bridge — it is not now passable.

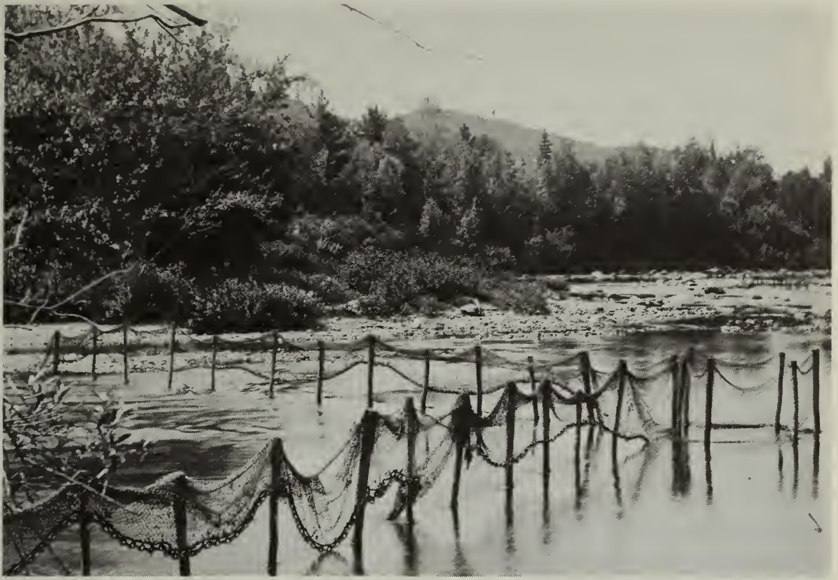

Figure 50. Although this picture was taken nearly 20 years following the first successful capture of adult salmon in the Pemigewasset River, it probably resembles the operation in 1879 quite closely. The net has been raised and is not fishing. The river is running from right to left. Photo taken in July of 1895.

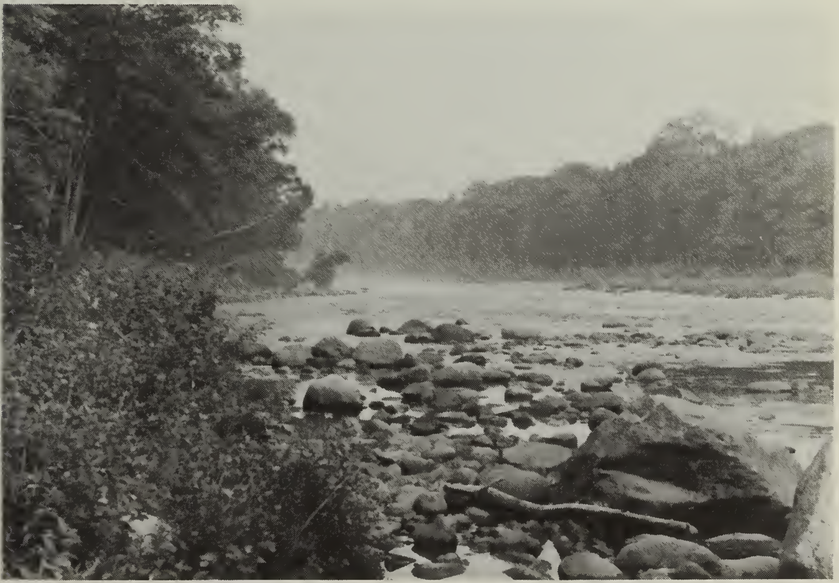

Figure 51. The area that the salmon net was positioned nearly 100 years ago has not changed a great deal today.

The following table summarizes the salmon statistics for the two years.

Statistic	1877	1878	1879
Number of salmon counted at the Lawrence Fishway	47	17	29
Today's estimate regarding the number of salmon passing the fishway	357	82	354
Number of salmon trapped at Livermore Falls	0	11	22
Number of eggs artificially taken	0	0	100,000
Today's estimate regarding the number of adult salmon reaching the spawning grounds	286	66	283
Number of Atlantic salmon fry released	0	0	0

Table 1. The observed and estimated salmon statistics for 1878 and 1879. The 1877 figures are included for comparative purposes. For a detailed description relative to the derivation of the estimates, the reader should refer to Appendix IV.

Author's Note

Although it is likely that the salmon run in 1878 was much stronger than the 80 individuals that I estimate passed the Lawrence fishway, I have not attempted to adjust the estimate to a more reasonable level in an effort to remain consistent. The fact that more salmon were observed passing the Amoskeag fishway than the Lawrence fishway, and the fact that 11 salmon were captured at Livermore Falls when the total run was estimated at 80 fish, substantiates that my estimate is far too low.

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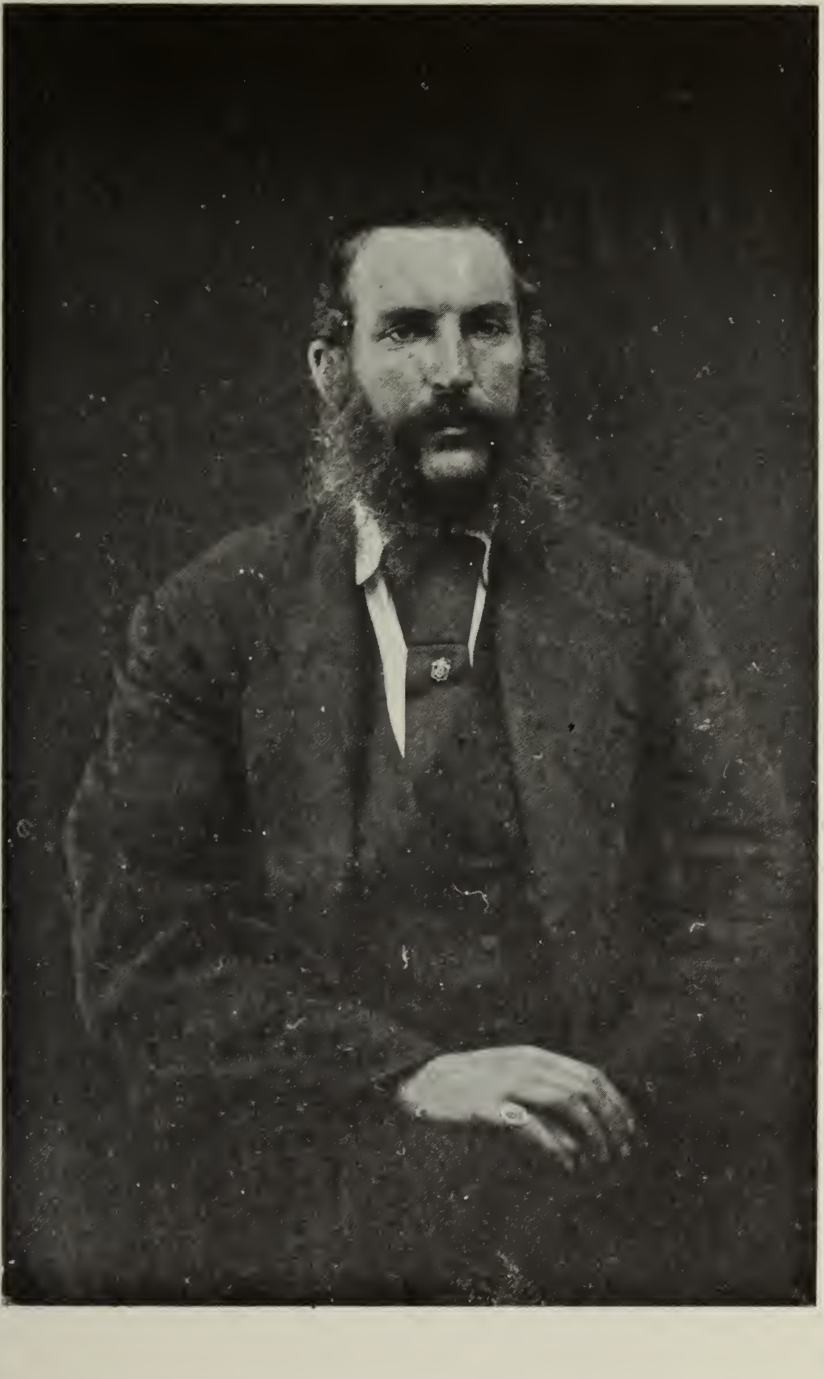

Elliott B. Hodge (Plymouth, New Hampshire) became the second superintendent of the state hatching-house in 1882. Photo courtesy of Robert Learned.

Chapter Eight

Chapter Eight:
A Period Of Drought

"Your commissioners report with pleasure the results of another successful year of fish-culture in New Hampshire, although the extreme and almost unprecedented drouth of the past summer has seriously interfered with the return of salmon to the head-waters of the Merrimack."

New Hampshire Fish and Game Commission

The years, 1880 through 1886, were extremely dry, and there were periods when returning Atlantic salmon reached the spawning grounds in very limited numbers, and only with extreme difficulty. The period saw runs of salmon fluctuate widely, but by-in-large increase in size. Very large fry-plants were made, which coupled with the natural reproduction that occurred provided the ingredients for large salmon runs to follow.

The Pemigewasset River was, in 1880, well seeded with fry during the spring, because of the natural spawning of the previous fall, and production of nearly 145,000 fish from the state hatching-house fry-plant.

The Atlantic salmon run that entered the Merrimack River during 1880, was probably the largest generated up to that time; one that I estimate exceeded 600 individuals. Although only 28 salmon were counted at the fishway, beginning on June 2, and ending on July 25, the count would probably have been considerably higher had water conditions within the river been more favorable.

During the entire year less than 31 inches of rainfall occurred at Concord, New Hampshire.[34] The Merrimack River, by mid-summer, was seriously low, since the months of February, March, April, May, June, and August received very little precipitation. It was reported that many of the salmon remained in the lower river during the summer months, and were taken by fishermen.[35]

However, some salmon were able to proceed up river and by July 9, 19 adults had been captured at Livermore Falls. Two additional adults were captured in October, bringing the total to 21 fish. Of the 21 fish captured, nine were females from which 60,000 eggs were taken artificially. The run of salmon in the Penobscot River was evidently quite strong, for an additional 420,000 eggs were procurred from Bucksport.

Since 21 fish were captured at the trapping site at Livermore Falls, it is likely that a significant number of salmon were able to spawn naturally in the Pemigewasset River. However, the reproductive potential of the large salmon run was probably not fully realized because of the unfavorable water conditions in the river.

During the summer of 1881, the Atlantic salmon fry in the Pemigewasset River were probably more numerous than at any previous time during the restoration effort. From the state hatching-house, nearly 445,000 fry had been released in June. This was the largest fry-plant yet made, which combined with whatever fry resulted from natural reproduction of the previous fall meant that the river was well saturated with young salmon.

The year 1881 was probably one of the more confusing of the entire restoration period. A fairly respectable run of salmon entered the Merrimack River (I estimate that about 650 salmon passed the Lawrence fishway). Seventy-two salmon were counted at the fishway; the first on June 7, and the last on July 30. A report issued by the New Hampshire Fish and Game Commission indicated that in no year since the river had been accessible to migratory fish, had so many salmon passed the fishways at Lawrence and Lowell.[30] However, no salmon fry had been released into the headwaters of the Merrimack River during 1877. Since it required approximately four years after a fry-plant before a major adult run occurred, one would not have expected a large number of salmon in 1881.

My estimate relative to the number of fish that passed the Lawrence fishway appears to contradict the records of 1881. Although there is the possibility that some of the salmon that returned were not Atlantic salmon but chinook salmon, there are no records to indicate that any chinook salmon ever returned. In fact all of the records pertaining to chinook salmon indicated that the introduction of this species was a total waste of time and money. I therefore, only assume that the fish count made at the Lawrence fishway, nearly doubled those of previous years, precipitated the very positive report.

It was reported that the extreme drought of the previous year continued during the summer of 1881, and that many salmon could not reach the entrance to the fishway at the Amoskeag Dam; many died on the rocks below. Although the precipitation records for Concord indicate that nearly 10 more inches of rainfall occurred than in the past year, a good deal of the precipitation that fell during the summer must have been in the form of intense thundershowers, effecting the flow of the river for only short periods.

Adult salmon did reach the Pemigewasset River and subsequently 25 were captured at Livermore Falls (the first fish was captured on June 20, and the last on September 26). Of the 25 adult salmon, 12 were females from which 125,000 eggs were taken during the last two weeks of October. An additional 350,000 to 370,000 eggs were obtained from salmon of the Penobscot River.

The salmon eggs obtained from Bucksport and those obtained from Merrimack River salmon hatched reasonably well. In June of 1882, 460,000 fry were liberated into the Pemigewasset River.

In June of 1882, Elliott B. Hodge, formerly a fish warden at Plymouth, became the superintendent of the state hatching-house at Livermore Falls. Mr. Hodge immediately set about to trap adult salmon below the falls and by June 20, had positioned the nets within the river. The Atlantic salmon run (estimated today at nearly 170 fish having passed the Lawrence fishway), began on June 17 and continued through September 29. The fish were reported to be rather large with many over 12 pounds. Fish capturing began on June 27, and continued until November 3. The summer of 1882, like the previous year, was a period of intensive drought. Mr. Hodge reported that from the 20th of July through the end of September the nets were of little value due to the extremely low water levels.[36]

However, during late September over seven inches of rain fell and many salmon ascended the river. Thirty-three adult salmon were captured and subsequently, 85,000 eggs were taken artificially. Although there is no indication that any of the 33 salmon did not survive their stay at the state hatching-house, one must assume that either some of the fish died or that the sex ratio of the captured fish favored males significantly. The 33 salmon should have provided many more eggs than the 85,000 recorded.

In January of 1883, nearly 320,000 eggs were obtained from the salmon egg procurement operation in Maine. These eggs in combination with the 85,000 already at the state hatching-house, were hatched with a loss of only about two percent.[37] And in June, 392,000 fry were released into the Pemigewasset River.

The summer of 1883 experienced probably the worst drought of the period; less than 30 inches of precipitation were recorded at Concord during the year. The only month when an appreciable amount of rainfall occurred was July, when over five inches were recorded. One can safely assume that this rainfall probably resulted from thunderstorm activity and was of very little consequence to the flow of the Merrimack River.

The adult salmon run that entered the river during 1883, was one of the smallest of the restoration effort. Only 12 salmon were counted at the Lawrence fishway (I estimate that 54 salmon actually passed the structure). It was reported however, that a rather healthy run of salmon passed the Amoskeag fishway during October, with a great deal of spawning occurring within the mainstem of the Merrimack River, downstream from the Pemigewasset River.[37] Some of these fish were successful in reaching the Pemigewasset River, because enough were trapped at the Livermore Falls site to furnish 75,000 eggs for the state hatching-house.

It is interesting to note that of the salmon observed and those captured, many were reported to have been extremely large, some measuring over 40 inches in length. These fish would have been by far the largest salmon yet reported to have returned to the river.

Up until 1883, the only reports relative to fishways invariably referred to Lawrence, Lowell, and Amoskeag; the structures at Hooksett, Garvins Falls, and Sewalls Falls were too small to warrant fishways. However, the dam at Garvins Falls must have been enlarged several years prior to 1883, because it necessitated the building of a fishway. This was confirmed by a note in the New Hampshire Fish and Game Commission report of 1884, which indicated that the fishway at Garvins Falls had been rebuilt the previous summer.[37]

Approximately 600,000 fry were released into the Pemigewasset River during the late spring of 1884. This plant, the largest yet made in the restoration effort, was the product of the egg procurement operation in Maine and the 75,000 eggs taken from fish captured in the Merrimack River the previous fall.

The salmon run in the river, beginning in early June, was six times greater than that of 1883 (estimated today at nearly 350 fish passing the Lawrence fishway). However, only 17 fish were actually counted in Lawrence. A substantial run of salmon also entered the Merrimack River during the fall, but was unable to proceed past Manchester because of low water.[26] The area had received very little rainfall from June through October.

Just as the preceding year, the salmon were primarily large individuals. Many were greater than 15 pounds and one specimen was reported to have weighed 35 pounds.

Although the river conditions were unfavorable for the upstream movement of the salmon, some of the fish were able to reach the spawning grounds, and 17 fish were eventually caught within the nets at Livermore Falls. During October and November, these captured fish were spawned, yielding approximately 50,000 eggs. Natural spawning within the Pemigewasset River is likely to have occurred also.

At the close of 1884, there must have been some doubt as to the value of the restoration effort. In fact, the Fisheries Commissioners may have begun to consider abandoning the procurement of eggs from the Bucksport operation and the resulting fry-release program. The drought conditions of the preceding years had taken a heavy toll in the number of salmon reaching the headwaters, and it is quite possible that public indifference had increased substantially. However, Professor Baird of the United States Fish and Fisheries Commission was very anxious that the fry planting program be continued and he urged the New Hampshire and Massachusetts Fisheries Commissioners to continue their work.

The work did continue, and in January of 1885, the Fisheries Commissioners were able to obtain nearly 500,000 eggs from Bucksport, Maine. These eggs plus the 50,000 taken artificially from salmon that returned to the Merrimack the previous year, resulted in a fry-plant of 500,000 within the Pemigewasset River.

I estimate that the adult run that entered the Merrimack River in May, and continued into October, was by far the largest yet (approximately 750 salmon passed the Lawrence fishway). The actual count at the fishway was rather low, only 17 fish.

It was reported that few salmon were able to reach the spawning grounds because of the continued drought conditions.[38] Precipitation records at Concord however, do not indicate that conditions were nearly as severe as reported. Rainfall had increased by nearly seven inches over that of the drought years, and the months of June through August were by no means dry.[34] Salmon did reach the spawning grounds and natural reproduction occurred. Seventeen fish were trapped at Livermore Falls and 50,000 eggs were subsequently taken.

The year 1886 (see Appendix IX) was quite similar to that of 1885. Six hundred thousand salmon fry were released into the Pemigewasset River, and I estimate that the adult run passing the Lawrence fishway numbered nearly 600 fish. The run commenced in early June and continued into November, with 14 fish actually counted at the fishway. Although flow conditions in the river must have been considerably better than in several of the previous years (nearly 39 inches of rainfall occurred at Concord), it was reported that the adult salmon met extreme difficulty in reaching and entering the fishway at the Amoskeag Dam.[39]

However, adult salmon, as in every prior year, were evidently quite persistent and some were able to negotiate the difficult reaches and enter the Pemigewasset River. Although the number of adult salmon trapped at Livermore Falls was not recorded, between 10 and 20 fish must have been captured because 50,000 eggs were obtained.

This seven-year period, 1880 through 1886, must be considered one of extreme frustration for those involved with the Atlantic salmon restoration effort. The extreme drought had taken its toll.

During this time period, 3.1 million fry had been released into the Merrimack River and over 3,100 (estimated) adult salmon had returned and passed the Lawrence fishway. The severely unfavorable water conditions within the river during the majority of the seven years had effected the salmon runs tremendously; less than 1,700 of the fish are estimated to have reached the spawning grounds and reproduced. Approximately 148 adult salmon were captured at the Livermore Falls trapping site, and nearly 500,000 eggs were taken artificially. The table on the following page summarizes these statistics on a yearly basis.

The state hatching-house at Plymouth was greatly expanded and had become the Plymouth Hatchery. Not only were Atlantic salmon released from the facility, but brook trout, landlocked

Statistic	1880	1881	1882	1883	1884	1885	1886
Number of salmon counted at the Lawrence Fishway	30	72	24	12	17	17	14
Today's estimate regarding the number of salmon passing the fishway	611	663	166	54	330	760	588
Number of salmon trapped at Livermore Falls	21	25	33	20	17	17	15
Number of eggs artificially taken	60,000	125,000	85,000	75,000	50,000	50,000	50,000
Today's estimate regarding the number of adult salmon reaching the spawning grounds	239	398	66	22	165	456	353
Number of Atlantic salmon fry released	143,000	443,000	455,000	392,000	600,000	500,000	600,000

Table 2. The observed and estimated salmon statistics for the Merrimack River from 1880 through 1886. The reader should refer to Appendix IV for a detailed description of the process used in the calculation of the estimates.

salmon, lake trout, sunapee trout, brown trout, whitefish, and chinook salmon were also released by the thousands. Broodstock from which many of the trout eggs were obtained were also reared at the hatchery. The activities of the Fisheries Commissioners had become quite broad and complex. One might safely conclude that the Atlantic salmon was no longer the focal point of the fisheries work that was being conducted.

The fishways at Lawrence, Lowell, and Amoskeag had been continually improved and were in excellent working order, and a new fishway had been constructed at Garvins Falls. At the close of 1886, the Fisheries Commissioners of Massachusetts and New Hampshire were predicting, based on the heavy fry-plants of the previous few years, that the fishways would be heavily used during the next few years; large salmon runs were expected.

Author's Note

Similar to the year 1878, the salmon runs of 1882 and 1883 probably exceeded my estimates. This is a reasonable assumption if one views the fish counts at the Lawrence fishway, and the number of salmon captured at Livermore Falls in relation to the population estimates calculated. Again, I have not attempted to adjust my estimates in an effort to remain consistent.

The unfavorable water conditions within the river, referred to continually in the records, bear further discussion. Although it is rather obvious from the precipitation records for Concord, that rainfall was in most cases considerably lacking, it is quite possible that some of the river flow conditions were not entirely due to rainfall. Nearly all of the statements relative to salmon not being able to proceed to the spawning grounds without great difficulty, centered around the Amoskeag fishway. There is a real possibility that there was adequate flow in the river — it was being routed to a point downstream from the fishway and dam. At times the majority of the water may have gone down the canal next to the fishway, and the only water directly below the dam would have been the water that entered the fish passage facility. Because of the nature of the area immediately below the dam, (it was a very rocky and ledge-filled area) this type of water utilization would have made it extremely difficult for the salmon to have reached the entrance to the fishway. In this situation the salmon would be quite visible and vulnerable to poaching, and in some cases even become stranded, with death likely.

The following verse (in, Association of River Authorities, Year Book of 1969, London, England), humorously describes the Atlantic salmon and its relationship to river flow. This situation is not so humorous today, and in fact, could be a serious problem.

A Poem

The sexual urge of a salmon
is stronger than anyone thinks
And in order to spawn in the Autumn,
it uses its natural instincts
To outwit the netsmen and anglers
pollutions, abstractions and such,
To get to that part of the river
where a mate is awaiting its touch
But this sexual urge can be thwarted,
as experienced fishermen know,
If one fixes at too low a figure
the Minimum Acceptable Flow!!
Anonymous

●

Chapter Nine

Chapter Nine:
The Drought Ends (1887-1891)

> *"As instructed by the Commissioners of Massachusetts and New Hampshire, I have rebuilt the hatchery that was destroyed by fire on February 29, 1888."*
>
> Elliott B. Hodge

One of the most significant factors influencing the salmon restoration effort during the late 1880's was the return of normal rainfall, which ended nearly a half-decade of drought.[34] The Merrimack River ran full for the first time in nearly seven years. The Atlantic salmon runs were large and a great amount of natural spawning resulted. The egg procurement operation at Bucksport continued at a fairly high level, which provided more salmon fry for the Pemigewasset River than at any previous time in the restoration effort.

During May of 1887, nearly 420,000 salmon fry were liberated into the Pemigewasset River. These fry were products of the 50,000 eggs taken from Merrimack River salmon the previous year, and the procurement of 400,000 eggs from Bucksport.

The adult salmon run (estimated today at nearly 1,500 fish passing the Lawrence fishway) was the largest that had been observed since the restoration effort began. From the first week of June through the month of September, 87 fish were counted at the fishway. The fish were large with one female captured at Livermore Falls, that was 40 inches in length and weighed 24 pounds. Interestingly, the first grilse (a fish having spent only one year at sea) recorded during the restoration program was captured at the Livermore Falls trapping site.[40]

Forty salmon were trapped at Livermore Falls and during October approximately 100,000 eggs were obtained from them. Many more salmon would have been captured but heavy rains during July and September continually washed out the nets. Salmon were reported throughout the headwaters of the Merrimack River, and natural spawning was probably significant.

On February 29, 1888, the Plymouth Hatchery was destroyed to a large extent by fire (the hatchery building was rebuilt that same year and modernized greatly). Four hundred thousand brook trout eggs were destroyed during the fire. The Atlantic salmon eggs did not suffer loss however, for 600,000 fry were distributed throughout the Pemigewasset River during the spring.

The adult salmon run of 1888 was again strong, and I estimate that about 2,000 adults passed the fishway in Lawrence. Many of these fish reached the headwaters of the Merrimack and spawned naturally. Thirty salmon were captured at the trapping site below Livermore Falls and during October, 100,000 eggs were obtained.

A large number of salmon were harvested in the lower Merrimack River and adjacent coastal areas. Evidently, the dramatic increase in the number of salmon returning to the river had encouraged a great many individuals to take to the river with their nets. In the New Hampshire Fish and Game Commission Report of 1889, it was stated that:[41]

> “A great loss of fish belonging to the river takes place every year by weir fishermen on the coast. One weirman reported nearly eighty salmon taken in

> his nets, and as he was liable to a fine of fifty dollars for each fish, it is not at all likely that he reported more than were actually taken."

It is probably wiser to assume that the weirman chose not to report his entire salmon catch rather than inflate his statistics.

The law governing the taking of adult Atlantic salmon appeared to be strong but evidently lacked the necessary enforcement. The following quote, although of an earlier period, may very well have been the case in the late 1880's:[35]

> "The fish wardens at Lowell and Lawrence are men of character, and have faithfully discharged their duties; but many of the wardens below Lawrence are as useless as the fifth wheel to a coach. If they exercise an influence, it is in favor of the violation of the law; and in some instances they are known to have directly aided in the destruction of the salmon."

How serious the illegal harvest actually was is only conjecture. However, one must assume that as the size of the runs increased so did the harvest. The latter was one activity that the Fisheries Commissioners did not wish.

In January of 1889, the Fisheries Commissioners again received a considerable number of eggs from Maine, which in combination with the eggs taken from the Merrimack River salmon during the previous fall, brought the total number on hand to well over 600,000. And in May, nearly 600,000 fry were released into the Pemigewasset River.

The adult salmon run of 1889 was considerably less than those of the previous two seasons, estimated today at a little over 1,100 fish passing the Lawrence fishway. Many salmon were reported to have reached the headwaters of the Merrimack and enough were trapped at Livermore Falls to provide in excess of 200,000 eggs. This was the largest number of eggs yet taken artificially in the program and would, for the second time, be more than the number obtained from Bucksport.

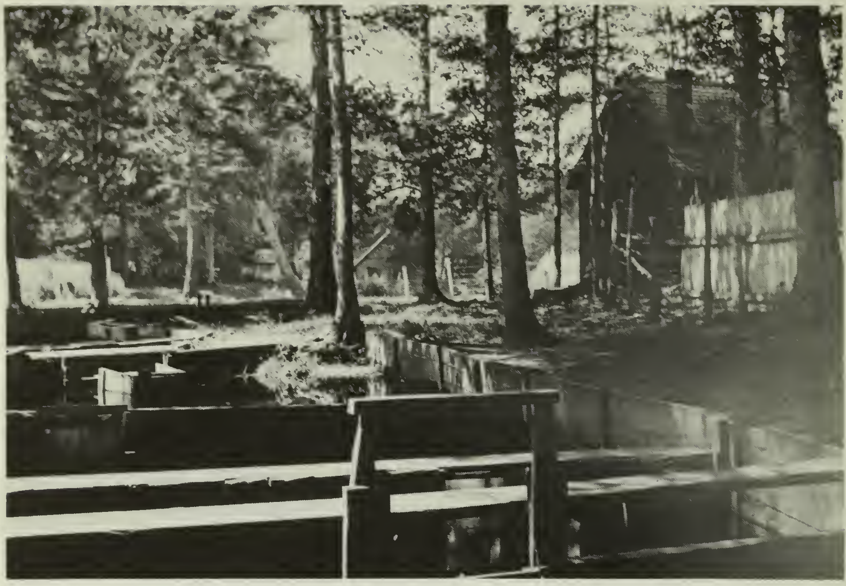

Figure 52. Although this picture was taken in the 1890's it resembles, probably very realistically, the Plymouth Hatchery after it was rebuilt in 1888. The principal building is shown here.

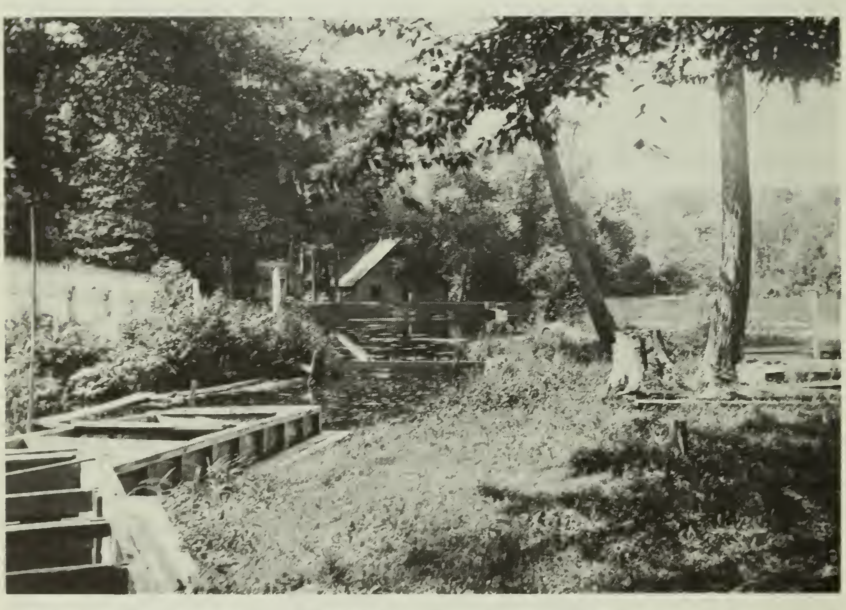

Figure 53. The hatchery building was situated just below the holding pond. A portion of the earthen bank and the small dam that held back the pond, as well as the broodstock (trout) holding facilities, are visible. Circa 1895.

It is interesting to note that the Plymouth Hatchery had expanded to a production of between one and two million fish of varying species, and these were being released on an annual basis.[42] The majority of these fish were released as fry. Some however, were reared for an extended period of time.

Very few eggs, 40,000 (see Appendix X), were obtained from Bucksport in February of 1890. In May, 240,000 fry were released into the Pemigewasset River. This was the smallest fry plant made in over a decade, but for the first time, the number of fry originating from Merrimack River salmon far exceeded the fry of Penobscot River origin.

The adult salmon run of 1890 was the second largest yet to enter the river. I estimate that approximately 1,800 adult salmon passed the fishway at Lawrence. The actual count, of course, was far less; 47 fish. The salmon reached the spawning grounds in large numbers and it was reported that as many as 50 salmon were visible at one time below Livermore Falls.[42] Sixty salmon were captured at the trapping site and it was believed that more than 100 would have been captured had not high water washed out the nets. During October slightly more than 200,000 eggs were taken from the fish, and the adult salmon then released back into the river. This marked the second year in succession that 200,000 eggs had been obtained from salmon returning to the Merrimack River.

The year 1890 also marked the first time that extending the rearing regime for salmon at the Plymouth Hatchery was discussed. Elliott B. Hodge, the superintendent, had an interesting reply to this topic:[42]

> "In regard to keeping the fry of the salmon until at least one year old, I consider it to be inexpedient, and, as far as this river is concerned, unnecessary, as the fry do not have to be carried for over one hour in the cans. The plant can be made before the yolk sac is absorbed, and, when ready to take food, they are in the same place that they would have been had they been hatched naturally in the river; and they are far more likely to find food more suitable to their wants than anything that can be supplied artificially at that season of the year."

Although there is a great deal of truth to what Hodge said, one must realize that the extended rearing of the salmon would have probably provided even more significant results in relation to adult returns, than the stocking of fry, had it been initiated. To optimize the results of the fry-release program, the fry would have to have been distributed over a rather wide area of the nursery habitat (something that was not totally feasible during the late 1800's)a) and would have to have coincided to a great degree with the natural cycle. The release of fry too early in the spring, before the food supply in the river was active, might have contributed to starving a goodly number of juvenile fish. Fortunately, the Fisheries Commissioners were able to hold the fry at the Plymouth Hatchery until May and June when the river conditions were entirely favorable to the young fish. The extended rearing of the salmon, on the other hand, would have bypassed many of the problems that the juvenile salmon (fry) faced after their release, and probably would have resulted in more fish actually moving down to the sea. With a greater number of fish leaving the river the chances would have been good that a greater number of adults would have returned. The question Mr. Hodge addressed is a difficult one with no easy answer. The fry stocking program was providing significant results.

The fry-release program continued during the spring of 1891, when nearly 332,000 young fish were released into the headwater areas. This was one of the smallest fry-plants made in a number of years, and like that of the previous year, related to a decrease in the number of eggs coming from the egg procurement operation in Maine (see Appendix XI).

The adult salmon run in 1891 was estimated at just over 1,600 fish successfully negotiating the Lawrence fishway. One of the larger counts, 67, was recorded that year.

It was reported that only the June run of salmon reached the Pemigewasset River where 75 were successfully secured at the Livermore Falls trapping site.[43] Low water within the river during the late summer was said to have prevented many of the salmon from going upriver beyond Concord.

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a) The fact that the railroad followed a great deal of the river did help in the distribution of fry.

A rather large number of salmon, weighing from 6 to 30 pounds, took refuge in several of the tributaries below Concord; many were caught by hook-and-line and some speared. The latter activity was stopped by the Fisheries Commissioners of New Hampshire.

During October over 200,000 eggs were obtained from the 75 salmon captured at Livermore Falls. Unknown to the Fisheries Commissioners of Massachusetts and New Hampshire, these would be the only eggs obtained from which fry would be produced for release in 1892.

Statistic	**1887**	**1888**	**1889**	**1890**	**1891**
Number of salmon counted at the Lawrence Fishway	87	74	41	47	67
Today's estimate regarding the number of salmon passing the fishway	1,500	1,927	1,141	1,796	1,653
Number of salmon trapped at Livermore Falls	40	30	52	60	75
Number of eggs artificially taken	100,000	100,000	200,000	200,000	200,000
Today's estimate regarding the number of adult salmon reaching the spawning grounds	1,200	1,542	913	1,437	992
Number of Atlantic salmon fry released	420,000	600,000	600,000	240,000	332,000

Table 3. The observed and the estimated salmon statistics for the Merrimack River for the period 1887 through 1891. The reader should also refer to Appendix IV.

The five-year period, 1887 through 1891, had been a very positive one. The entire program had become a finely tuned routine. The idea of extending the rearing regime for the salmon had been discussed and rejected. Over 2.1 million Atlantic salmon fry were released into the Pemigewasset River, and more adult salmon passed the Lawrence fishway (estimated at greater than 8,000 adults) than in the entire 10-year period, 1877 through 1886. A record number of salmon, estimated at over 6,000 fish, reached the spawning grounds. And greater than 250 adults were captured at Livermore Falls from which approximately 800,000 eggs were secured.

Of great impact on the program was the development of an intensive commercial fishery for salmon. The situation in this area was definitely not encouraging to the Fisheries Commissioners.

Author's Note

The intensive commercial, illegal, fishery in the lower Merrimack developed rapidly during the five-year period. The only legal method for taking salmon was by hook-and-line. The penalty for taking salmon in any other way was reported to be at least 50 but not more than 200 dollars for each illegally caught salmon.[44] This penalty, severe as it was, did not deter the unlawful fishermen — it was not rigidly enforced! The following statement describes the situation and the feelings of the Fisheries Commissioners near the end of the five-year period:[45]

> "Although the number of salmon taken (referring to Livermore Falls) was larger than ever before, yet many of them ran very small, some not giving over 3,500 to 4,000 eggs. This is a good showing, considering the great numbers which are annually unlawfully destroyed by the gill nets and weirs before they have time to enter the river for spawning. But for this destruction the river would now be teeming with these fish, and would be a great resort for those who take them with hook-and-line. The planting of a great salmon river has been successfully established. There are no impediments to the passage of these fish to the headwaters of the river, and as yet no impurities in the water injurious to them.

The English government, by wise laws strictly enforced has been able to maintain their salmon fisheries to their full capacity. When it is remembered that the river Tay, a stream very much smaller than the Merrimack yields an annual return of from 65,000 to 70,000 salmon, and that it pays a rental of $75,000 per year, some idea may be formed of what the Merrimack would be if the salmon could be protected until they became sufficiently numerous to be self-sustaining. There is no speculation or theory in this; it is simply a common sense, business view based upon what had repeatedly been accomplished elsewhere. If the weirmen would cooperate with the commissioners by liberating the salmon taken in their traps, the greatest impediment to the increase of salmon would be removed."

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Chapter Ten

Chapter Ten:
Great Successes
But The Salmon Lose - 1892 Through 1897

"And with only the chant of the falls in the silence,
While the nets and the spears uncared for lay,
Again as of old the Christ was standing
By the lodges of Passaconaway."
From 'At The Falls Of Namoskeag'
Allen Eastman Cross (Circa 1906)

The years 1892 through 1897 provided the greatest success and the most dramatic disappointments of the entire restoration effort. From 1892 - 1895, adult salmon were denied access to the spawning grounds above Concord because of the Sewalls Falls dam. The building of a fishway in 1895 at this site was to no avail — the fishway at Lawrence was destroyed during an extensive spring flood. Tragedy befell the Atlantic salmon for a second time.

Although only 200,000 fry (the lowest number released in 12 years) were released into the Pemigewasset River, the year of 1892 provided the greatest achievement yet in the program. I estimate that over 3,000 salmon passed the Lawrence fishway (84 were actually counted). Adult salmon were first observed in the fishway on June 8 and counted until the 13th of July. As many as 11 salmon were observed in a single day's 15 minute counting period.

Unfortunately, the adult salmon were not able to move upstream beyond Concord. The Sewalls Falls dam was being rebuilt. It is quite likely that during the summer, the dam at Garvins Falls was also enlarged, for in 1893 it too presented a problem to the salmon.[46]

It is of interest to note that in 1892, anglers began to fly-fish for adult salmon, and it was reported that fish were caught below the Lawrence dam and between Lowell and Concord.[44] However, many of the salmon were taken illegally with the weirs, dynamite, and spears, in the lower river, the Nashua area, and in the Suncook River. The fact that salmon were entering the Suncook River attests to the fact that the Sewalls Falls dam was a hindrance.

Since adult salmon were unable to reach the spawning grounds, no eggs were obtained at the Livermore Falls trapping site and no fry would exist in the headwaters in 1893!

The adult salmon run in 1893 commenced early (May 28) and continued throughout the summer into the late fall. The run was again exceptionally large with over 3,600 (today's estimate) calculated to have passed the Lawrence fishway (97 salmon were actually counted).

Salmon were again pursued by fly-fisherman with some success which prompted Thomas S. Holmes to write:[47]

> "This would indicate that fisherman will be rewarded with considerable sport, if they have patience to follow it up, in fishing for salmon below Lawrence."

Atlantic salmon were also caught by fly-fishermen in the Manchester and Concord areas.

Atlantic salmon were again denied access to the Merrimack River above Concord. Thus, no fish reached the headwaters, no fish were trapped at Livermore Falls, and the nursery areas in the Pemigewasset River were devoid of salmon fry for a second straight year.

A number of adult salmon were able to surmount the Garvins Falls dam because of favorable water conditions, for many congregated at the base of Sewalls Falls dam during the summer, and were captured. It can safely be said that salmon also entered the tributaries downstream from the dam in Concord.

The Atlantic salmon run that occurred during 1894, which I estimate to have been greater than 900 fish passing the Lawrence fishway, was unusually small in relation to the runs of 1892 and 1893. Only 11 fish were counted at the fishway, the first on May 19 (a very early beginning), and the last on October 22.

The salmon again, could not move above Concord because of the Sewalls Falls dam. The state of New Hampshire, however, attempted to end the access problem, and entered a lawsuit against the proprietors of the dam relative to fishway construction. The state was also negotiating with the proprietors of the Garvins Falls dam for the same reason.

Although it was reported that a new fishway at Garvins Falls dam was completed during 1894,a) the Concord Land and Water Power Company did not comply with the New Hampshire law, compelling them to provide fish passage at the Sewalls Falls dam until 1895.[48]

It is interesting to note that a bill was submitted to the Massachusetts legislature to abolish all laws for the protection of fish in the lower Merrimack River.[48] The bill, however, was vetoed by the

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a) It is questionable whether a new fishway was constructed at Garvins Falls. The dam could have been negotiated by the salmon during periods of moderate to high flow. When Charles G. Atkins visited the area in 1895 (see Appendix XII) he did not mention a fishway in his diary, yet he discussed the new fishway at Sewalls Falls. Even his pictures of the Garvins Falls dam did not reveal the presence of a fishway. As meticulous as Mr. Atkins was in keeping exacting records, I must conclude that the old fishway at Garvins Falls was destroyed when the dam was remodeled in 1893, and a new fishway was not constructed.

Governor. From the standpoint of the Atlantic salmon, this bill, even if it had passed, would not have impacted the salmon restoration effort. For three years in a row, no salmon fry had been released or produced naturally in the Pemigewasset River. It was only a matter of time before adult salmon runs would cease altogether.

The adult salmon run of 1895 was considerably larger than that of the previous year, with over 1,700 adults estimated to have passed the Lawrence fishway (52 were actually counted). One individual who lived along the river between Lawrence and Haverhill, Massachusetts informed Thomas S. Holmes (the man in charge of the fishway at Lawrence), that there were few days, from July until the middle of September, that salmon were not seen or heard jumping in front of his house.[49]

The salmon, unable to reach the spawning grounds above Concord, because of fish passage construction, were in many cases forced to take up refuge in the tributaries below Concord. It was reported that large numbers of salmon were illegally captured in the Soucook River.[49] In the same report, it was stated that this activity

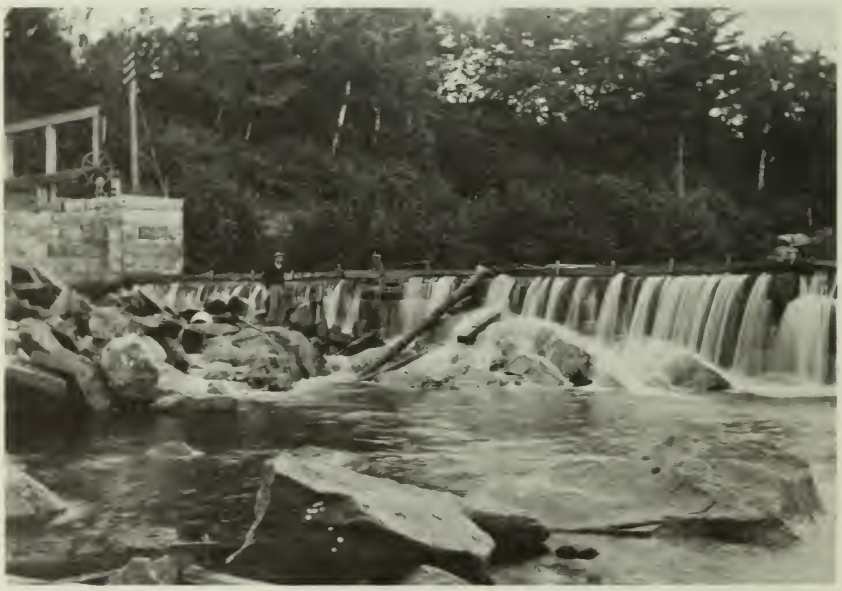

Figure 54. **The Garvins Falls dam in 1895 would have been difficult for the salmon to have passed at low water.**

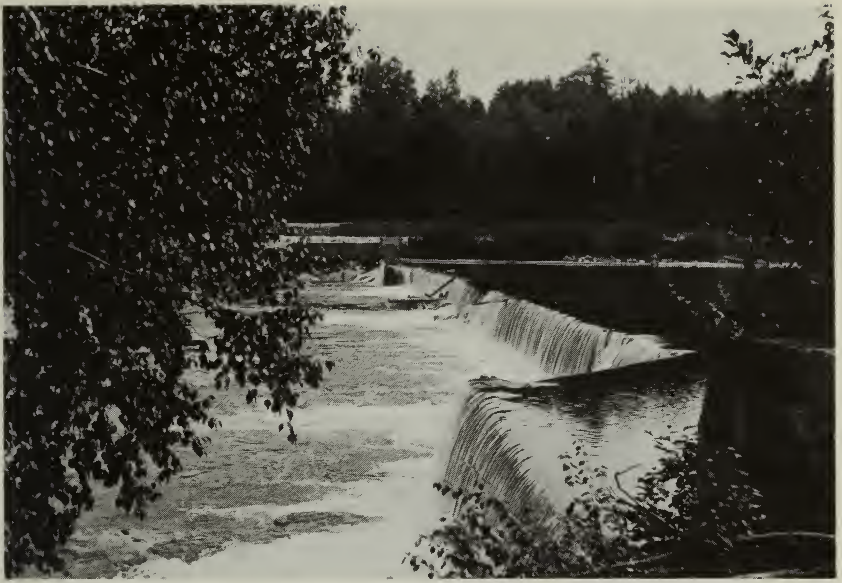

Figure 55. During the periods of moderate river flow, the Atlantic salmon were able to surmount the dam.

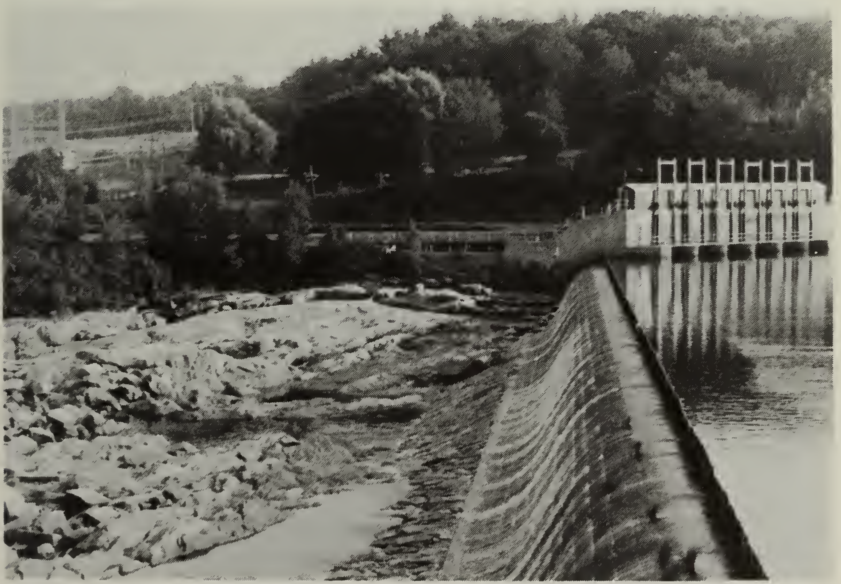

Figure 56. The Garvins Falls dam in 1980, is a formidable obstacle to the Atlantic salmon restoration effort. Several fishways will probably have to be constructed at this structure.

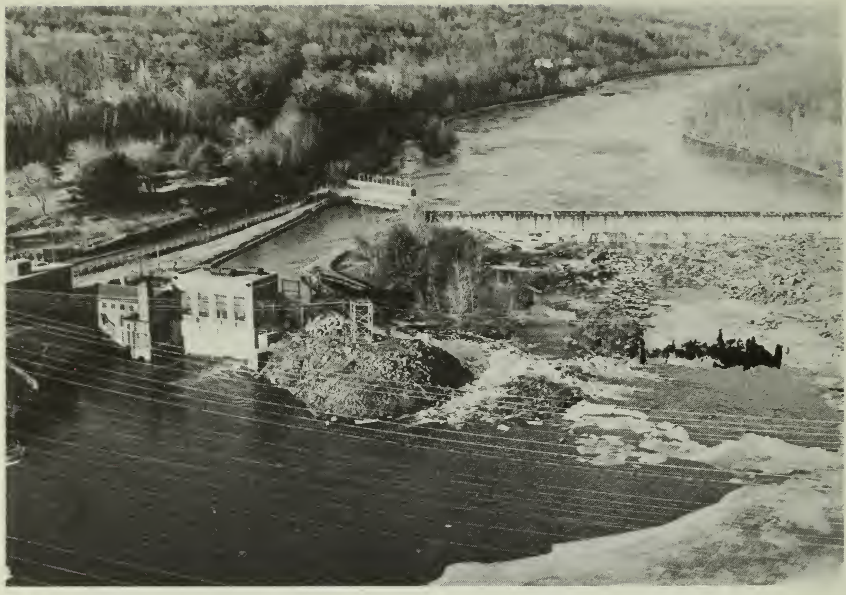

Figure 57. This aerial photo, courtesy of Wayne Nelson of the Public Service Company of New Hampshire, shows the complexity of the situation today.

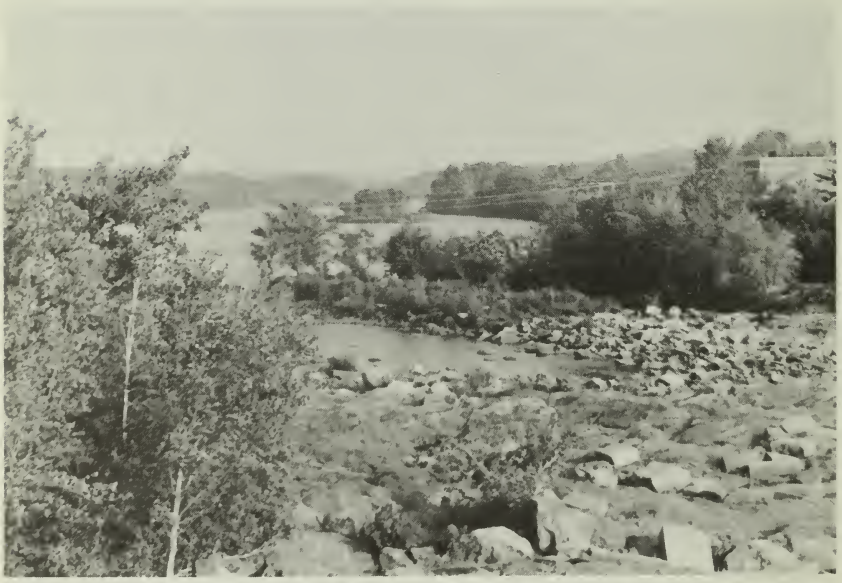

Figure 58. The area below the Garvins Falls dam is heavily strewn with boulders and is often dewatered during periods of low flow (1980).

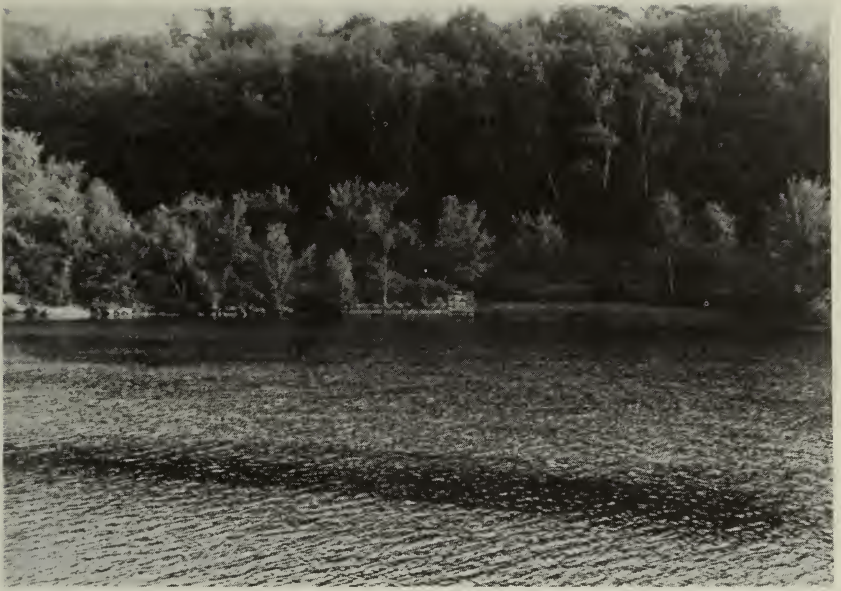

Figure 59. The original Garvins Falls dam was located several hundred yards upstream from the present-day dam. This 1980 photo shows part of the old dam abutment on the west side of the river. The old structure is now several feet beneath the surface of the river.

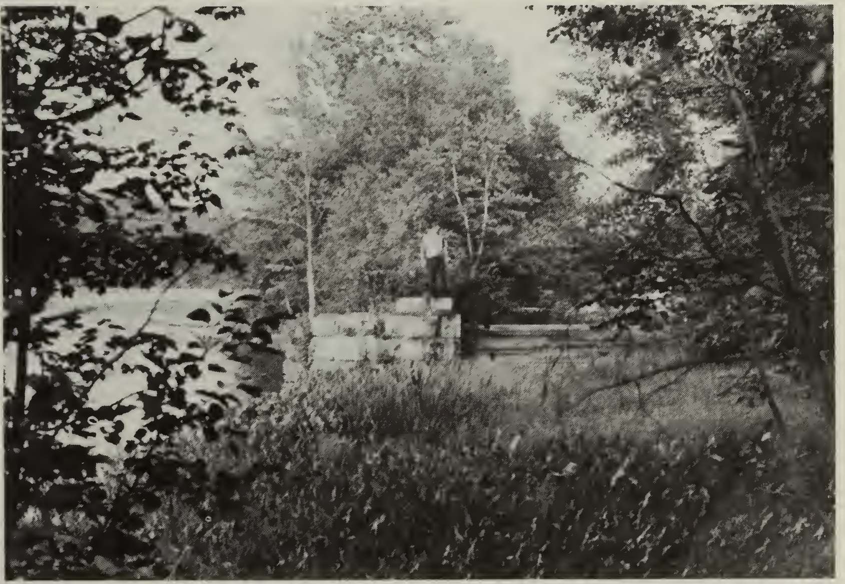

Figure 60. Here, in 1979, Philip Wightman, a former Fisheries Biologist with the New Hampshire Fish and Game Department, is standing on the original west bank Garvins Falls dam abutment. The wooden structure just to the right of the abutment is the upstream gate of the once active Bow canal.

was confirmed by an agent of the United States Fish and Fisheries Commission, who was at the time assessing the Soucook River drainage, relative to the feasibility of establishing an American shad hatchery.a)

The year 1896 must have been very demoralizing to the Fisheries Commissioners of Massachusetts and New Hampshire. The dam at Sewalls Falls, which was provided with a fishway in 1895, would never be used by salmon.b) A large spring flood accompanied by moving ice destroyed much of the Lawrence fishway. Salmon could not move past the first dam on the river!

The salmon run that would have passed the fishway at Lawrence (I estimate that the number would have been about 1,000 fish) was also the last major run that would enter the Merrimack. These salmon remained in the river below Lawrence throughout the summer, and it was reported that many were observed attempting to leap the Lawrence dam; especially from June 25 through July 25.[50] Some salmon were netted at the base of the dam and transported above the structure; however, this amounted to less than a dozen fish.

Plans to rebuild the Lawrence fishway were formulated during 1896, with construction to begin when the water conditions within the river became favorable during 1897. The fishway was not completed until 1898; however, by then it was too late. Only a few salmon (I estimate 250 fish) returned in 1897, and only a handful in 1898.

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a)The agent of the United States Fish and Fisheries Commission was Charles G. Atkins. In his diary of August 1895 (see Appendix XII), he described his visit to the Soucook River. He did not see any salmon and did not confirm the illegal activities as was suggested in the report. He did however, indicate that salmon had spawned within the river in the past.

There is a reference in his diary to salmon having been in the river earlier in 1895.

b) Atkins also visited the Sewalls Falls fishway at the same time and stated that the structure was too steep and would not pass salmon. This may be one reason why it was reported that salmon could not move above Concord (see Appendix XII), when in fact, it is known that the Sewalls Dam fishway existed during part of the summer of 1895.

The Pemigewasset River had not been stocked with salmon fry nor produced any fry through natural reproduction since 1892. The tributaries in the lower river were evidently not capable of producing any numbers of salmon, at least not enough to sustain the population.

Although the six-year period, 1892 through 1897, produced nearly as many adult salmon (I estimate that over 10,600 fish passed the Lawrence fishway) as the combined runs of the previous 15 years, not a single one of these fish ever reached the Pemigewasset River, their spawning grounds.

The illegal harvest of salmon had intensified dramatically and sport fishing was beginning to develop. After serious legal battles, the necessary fishway at Sewalls Falls was constructed, only to be negated by the destruction of the Lawrence fishway.

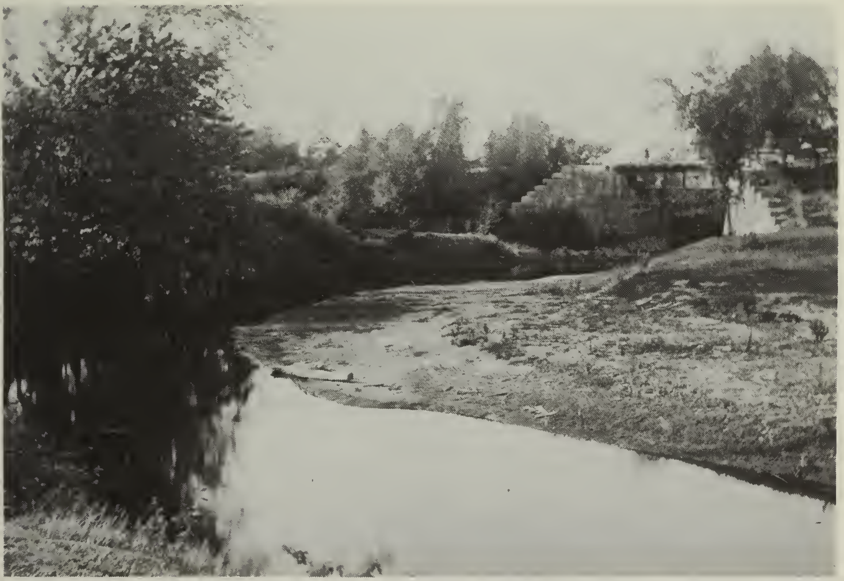

Figure 61. The Soucook River is a rather small tributary to the Merrimack River having some habitat favorable to the Atlantic salmon. The railroad bridge on the lower river is shown here. August, 1895.

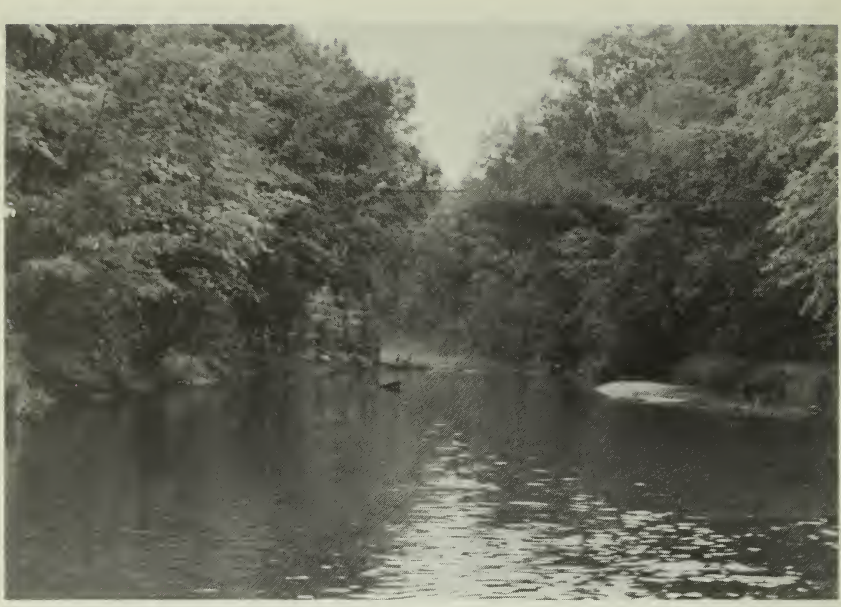

Figure 62. The same area today (1980) is heavily grown over — the only remnants of the railroad bridge being the abutments.

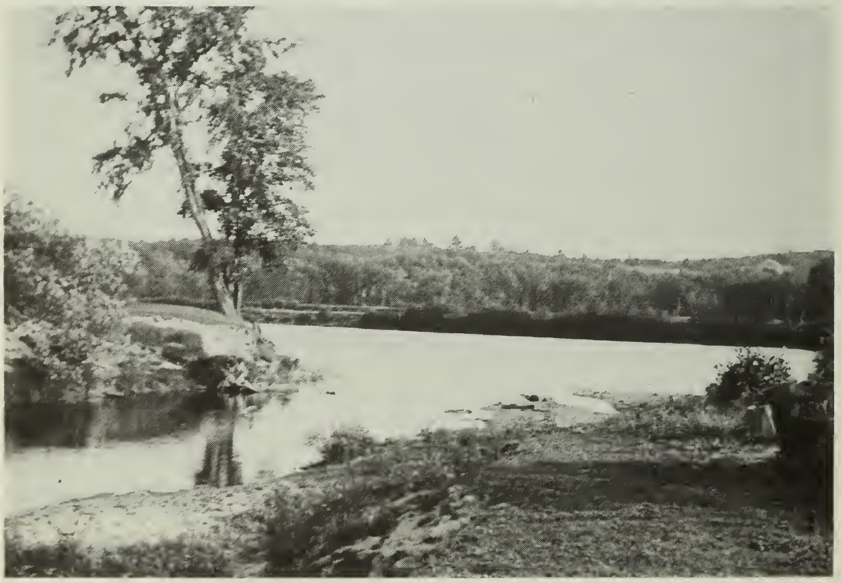

Figure 63. The mouth of the Soucook River was rather devoid of foliage when this photo was taken during August of 1895.

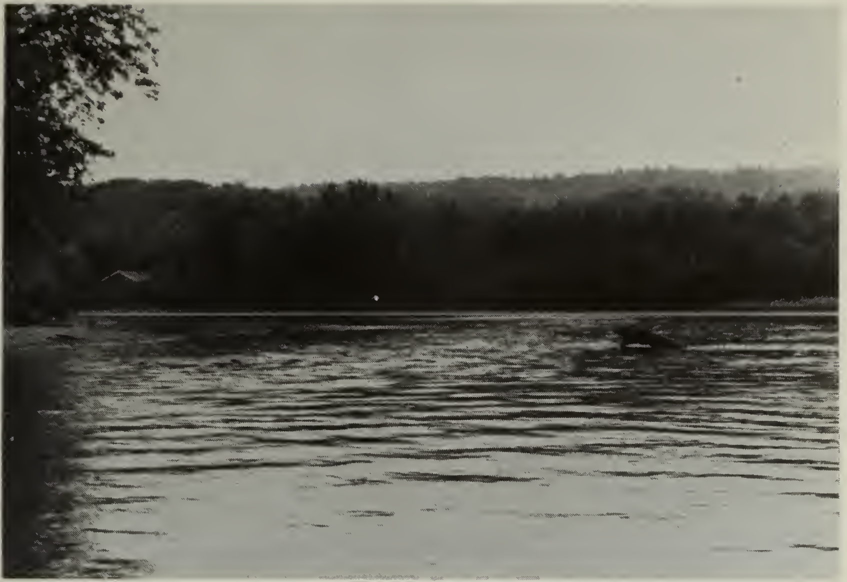

Figure 64. The area where the Soucook River empties into the Merrimack has changed a great deal from that depicted in the previous picture. This photo was taken during 1980.

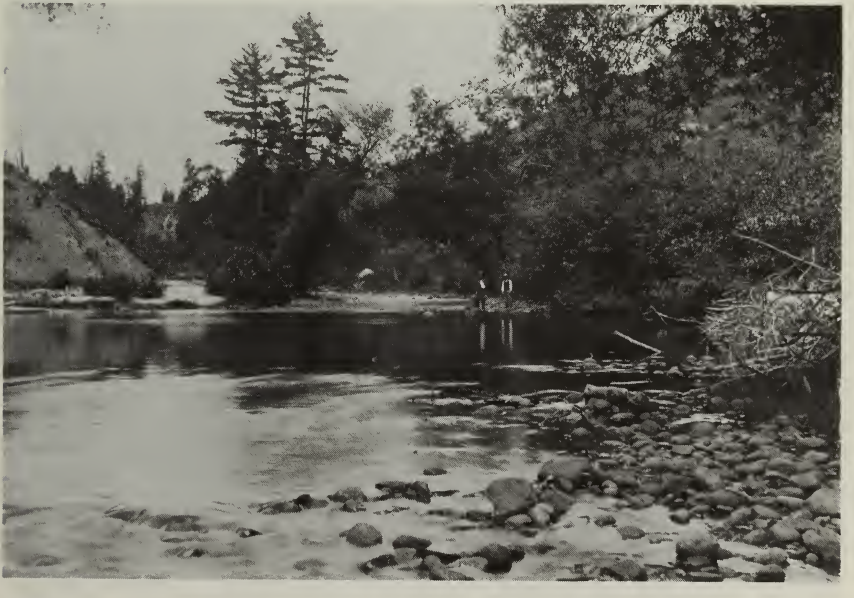

Figure 65. Some of the waters frequented by the Atlantic salmon in the Soucook River about one and one-half miles from its mouth are shown here. It is not known who the two men standing on the far bank are. August 1895.

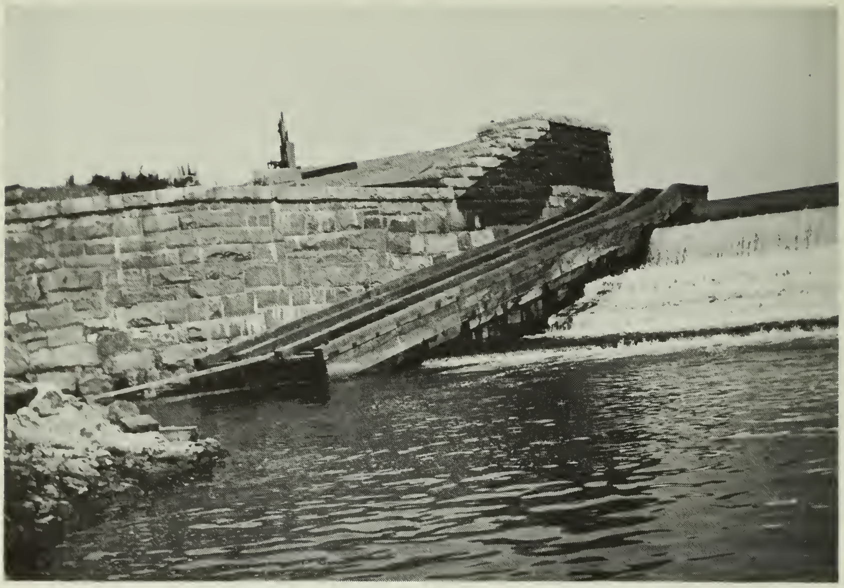

Figure 66. The fishway at Sewalls Falls dam, constructed during the early summer of 1895, was a heavy wooden timbered structure. Unfortunately, it was never adequately tested. August 1895.

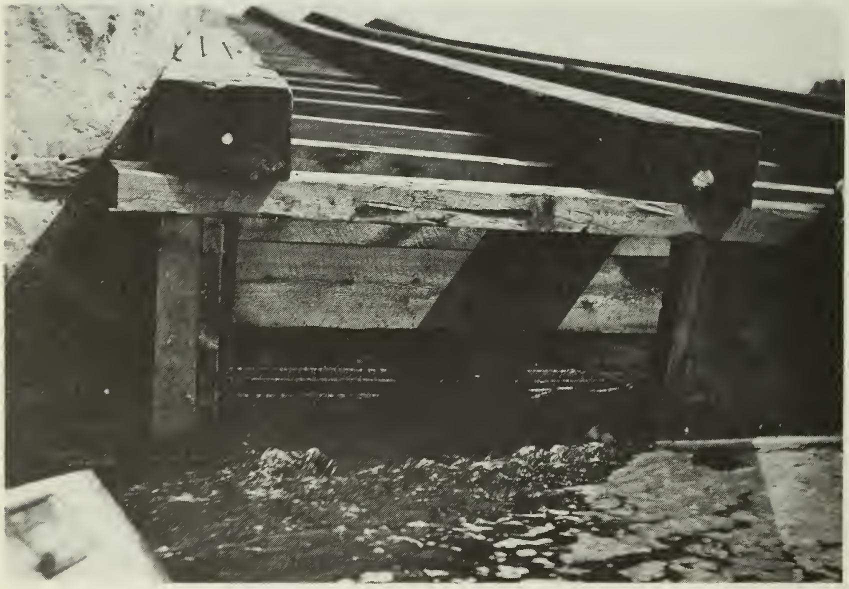

Figure 67. The entrance to the fishway at the Sewalls Falls dam is shown here as it appeared in August of 1895.

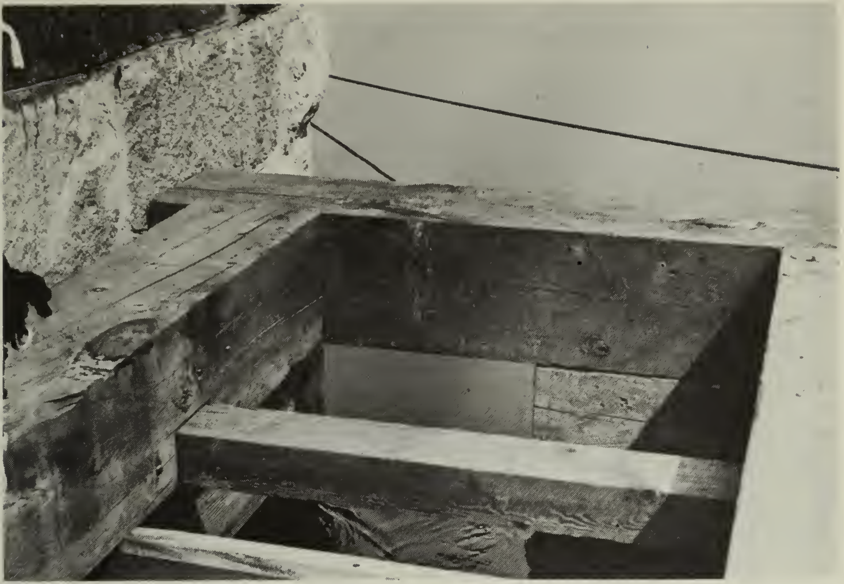

Figure 68. This August 1895 picture shows the Sewalls Falls fishway exit.

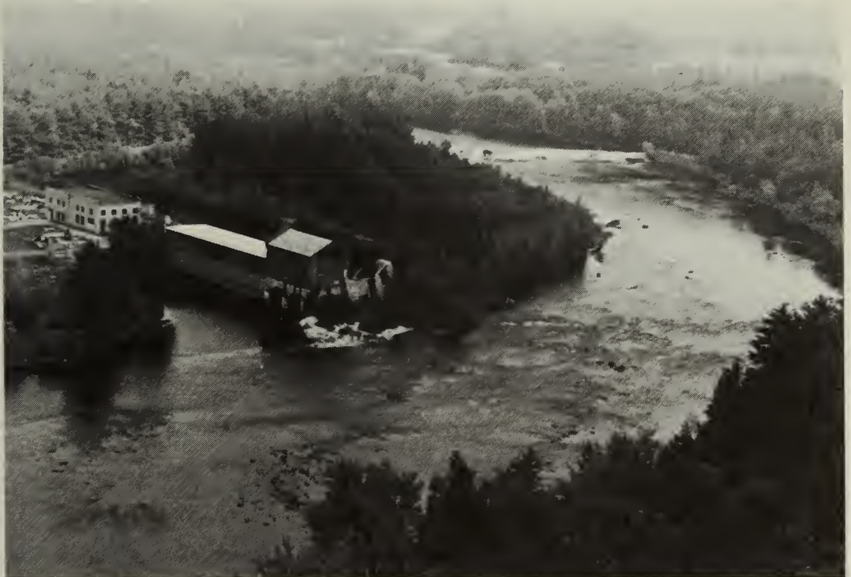

Figure 69. The dam at Sewalls Falls today, other than being in need of repair, has changed very little from the structure shown in 1895. The difference being that no fishway now exists. Picture, courtesy of Wayne Nelson of the Public Service Company of New Hampshire.

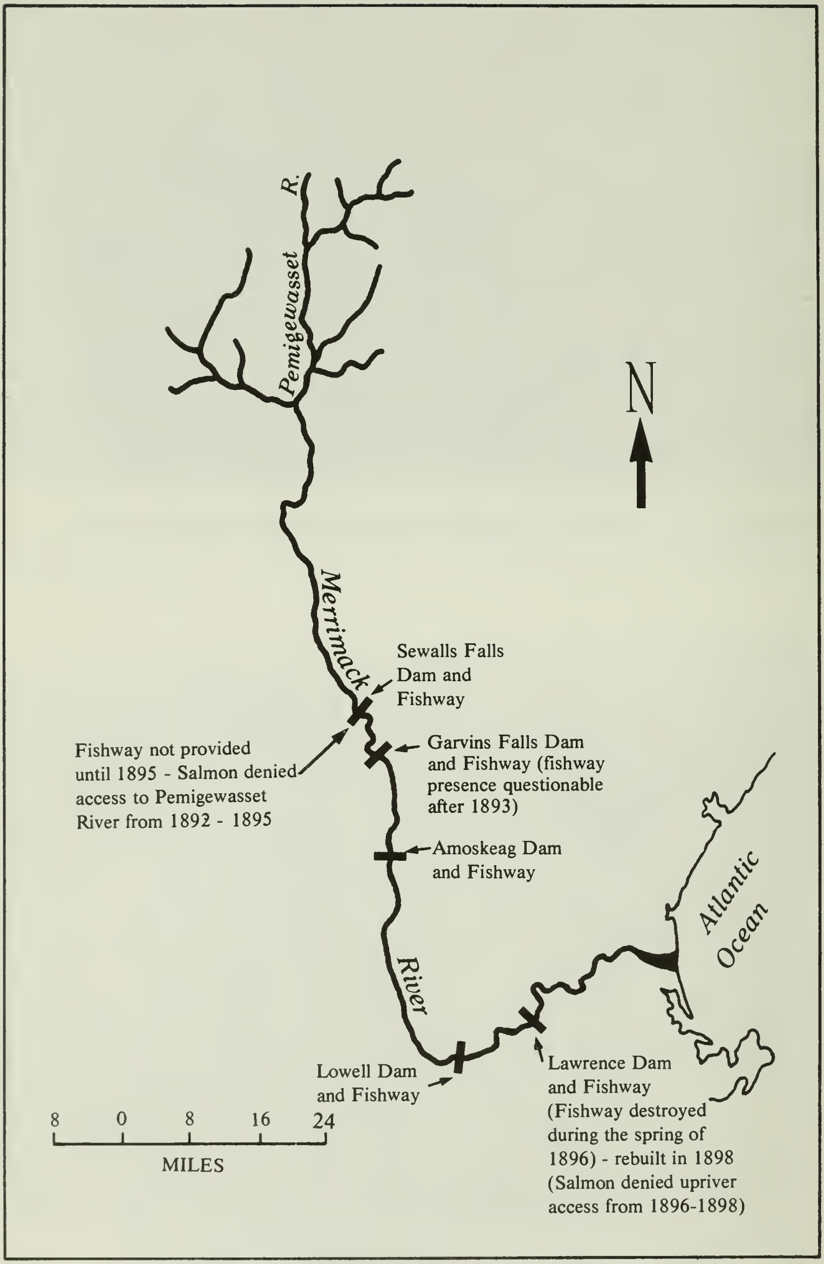
Pemigewasset R.
N
Merrimack
River
Sewalls Falls Dam and Fishway
Garvins Falls Dam and Fishway (fishway presence questionable after 1893)
Fishway not provided until 1895 - Salmon denied access to Pemigewasset River from 1892 - 1895
Amoskeag Dam and Fishway
Atlantic Ocean
Lowell Dam and Fishway
Lawrence Dam and Fishway (Fishway destroyed during the spring of 1896) - rebuilt in 1898 (Salmon denied upriver access from 1896-1898)
8 0 8 16 24
MILES

Figure 70. The dams, fishways, and important events relative to the Atlantic salmon restoration effort in the Merrimack River during the late 1800's are shown in this figure.

Statistic	1892	1893	1894	1895	1896	1897
Number of salmon counted at the Lawrence Fishway	84	97	11	52	0	0
Today's estimate regarding the number of salmon passing the fishway	3,062	3,600	929	1,776	1,034	241
Number of salmon trapped at Livermore Falls	0	0	0	0	0	0
Number of eggs artificially taken	0	0	0	0	0	0
Today's estimate regarding the number of adult salmon reaching the spawning grounds	0	0	0	0	0	0
Number of Atlantic salmon fry released	200,000	0	0	0	0	0

Table 4. The observed and estimated salmon statistics for the Merrimack River for the period 1892 through 1897. The reader should also refer to Appendix IV.

Author's Note

In 1895 it was written:[49]

> "The efforts to restock this river with salmon will form an interesting chapter in the history of fish culture, and their success or failure will depend entirely upon the protection given them throughout the entire length of the river. Had they been properly protected, the river would now be full of them, and both states would annually receive thousands of dollars from anglers who now go to the Provinces in pursuit of this fish."

There is some truth in the quotation. However, in spite of the fact that New Hampshire and Massachusetts were unable to control the harvesting of returning salmon, it is doubtful that the illegal fishing activities were as significant as the statement implies.

The ultimate success or failure of the restoration program depended on fish passage, and the annual release of salmon fry and/or naturally produced fry in the Pemigewasset River. When the operation on the Penobscot River in Bucksport, Maine did not provide eggs for the effort (1892 and thereafter), the program depended solely on fry produced from salmon returning to the Merrimack River. With the spawning grounds and the Livermore Falls trapping facility located in the headwaters, fish passage became the crucial factor.

When the dam at Sewalls Falls was remodeled, with no thought of providing a fish passage facility (1892 through 1895), the Atlantic salmon was denied its mechanism for perpetuation. At the close of 1895, with access again available to the salmon, there existed a glimmer of hope. This glimmer faded entirely, however, when the Lawrence fishway was destroyed by flood and ice before the salmon entered the river in 1896. So ended one of the most dramatic efforts to restore salmon to a river in which the former runs had been annihilated!

●

Chapter Eleven

Chapter Eleven:
Success Or Failure

"What if ...."

One can always wonder, what if the fishway at Sewalls Falls had been provided in 1893, and the Lawrence fishway had not been destroyed? Would the Atlantic salmon have been a part of the river today? The fact that the salmon runs were significant, and that sport fishing was beginning to develop, could provide a great deal of debate relative to this question.

We must, however, acknowledge the successes that were generated. Over 6.3 million Atlantic salmon fry were released into the Merrimack River system, 839 adults were counted at the Lawrence fishway during the 284 hours that the fishway was closed for that purpose. This represented only two percent of the running time of the facility. About 22,600 adult salmon were estimated to have passed the Lawrence fishway, 438 adults were successfully trapped at Livermore Falls, over 1.3 million eggs were artificially spawned, and five fish passage facilities were constructed (some several times).

The results are even more significant in view of the times. Fish culture was in its infancy. Fish passage design was far less sophisticated than today, and probably much less effective. Travel was relatively slow, and at times nearly impossible. One could not use the automobile, the airplane, or the helicopter to transport salmon fry (or eggs) to the nursery areas for release. Thus, even the fry stockng program could not have been as effective as it can be today. Yet, given the hardships of that era, tremendous accomplishments were realized.

Yes, the early restoration effort was successful, highly successful. We have yet, in over a decade of attempting to restore the Atlantic salmon to the Connecticut and Merrimack Rivers (1970 through 1980), been able to duplicate what was accomplished on the Merrimack River. Perhaps we can learn from the experience of the mid to late 1800's.

There are many similarities between the two programs. The restoration effort in the 1800's relied on a spirit of cooperation among Massachusetts, New Hampshire, Maine, and the United States Fish and Fisheries Commission. Today's plan relies on that same spirit of cooperation. There are more players, however. The Massachusetts Division of Marine Fisheries and the Division of Inland Fisheries and Wildlife, the New Hampshire Fish and Game Department, and two Federal agencies: the United States Fish and Wildlife Service, and the National Marine Fisheries Service are the cooperators. Today's program will be dependent on fish passage; the problems being similar to those of the last century but of a far greater magnitude. Today's program relies on obtaining eggs from adult salmon of the Penobscot River as well as Canadian rivers. Today's program also includes the Pemigewasset River relative to salmon spawning and nursery habitat. Atlantic salmon fry are presently being released into the Pemigewasset River, and juvenile salmon have and are being caught by fishermen in the headwaters. Posters, displaying the differences between young salmon and various trout species, and urging the fishermen to return the young salmon unharmed to the water, have been distributed in the exact same manner as in 1877.

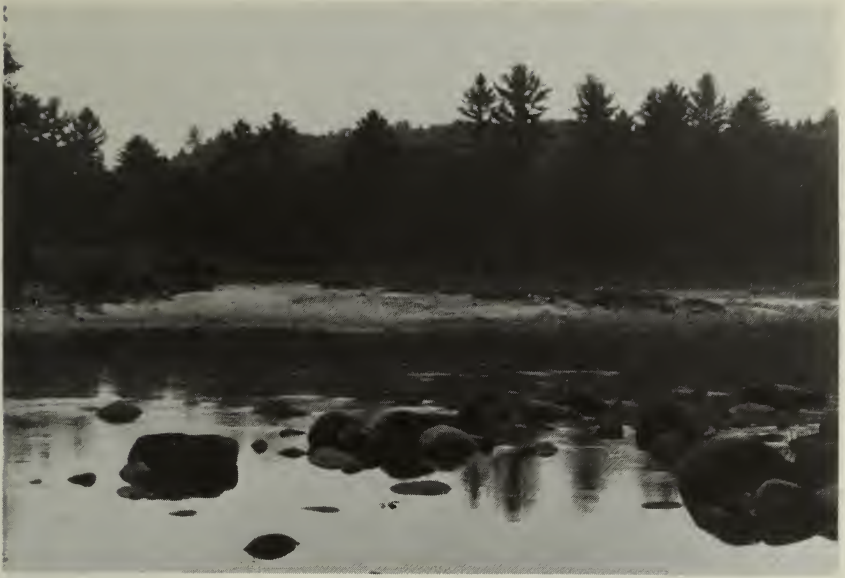

Figure 71. Today (1980), the Pemigewasset River just downstream from the site of the historical state hatching-house has changed very little.

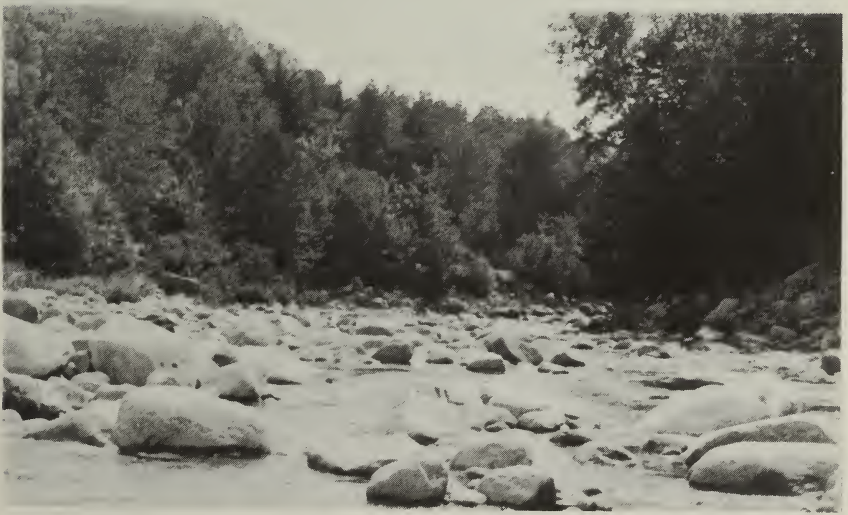

Figure 72. In 1980, this area of the Pemigewasset River just downstream from Livermore Falls is probably quite similar to the area over 100 years ago. The Atlantic salmon habitat is still there.

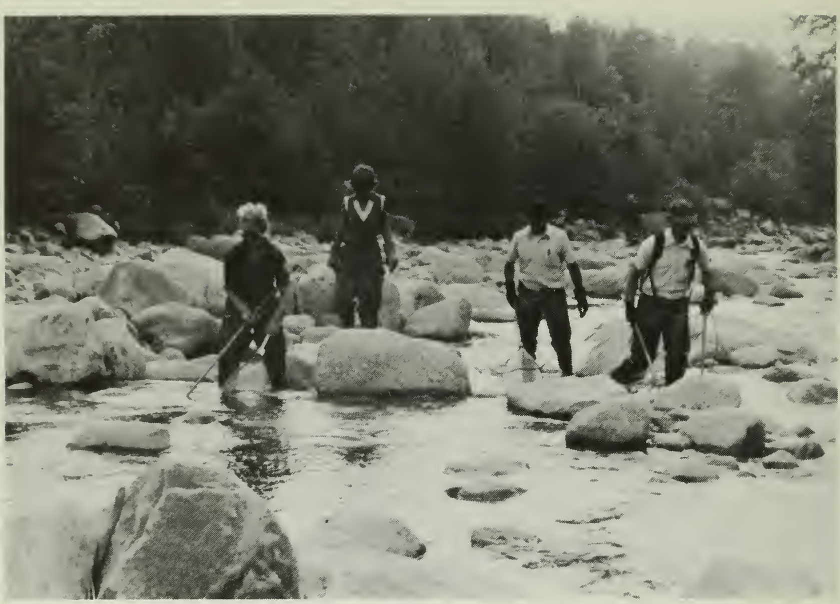

Figure 73. As part of an ongoing research program, the United States Fish and Wildlife Service and the New Hampshire Fish and Game Department are releasing Atlantic salmon fry into the Pemigewasset River system. Sampling efforts are indicating that the fry are surviving and growing well.

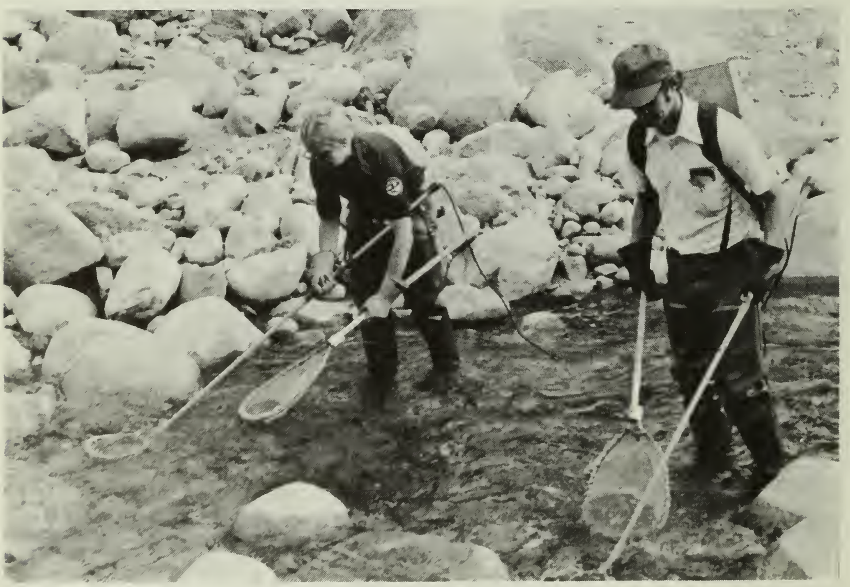

Figure 74. The research program has intensified in recent years, and will probably be expanded to additional areas within the Merrimack River basin.

There are a number of striking differences between the two efforts. Today's program will require a far greater amount of time before fish passage problems will be overcome. There is also the possibility that the juvenile salmon, when moving to the sea, will require downstream passage facilities at the hydro-electric dams in order to avoid excessive turbine mortalities. This, of course, was not a serious problem in the 1800's. Today, Atlantic salmon, while in the ocean, will face major commercial fisheries in West Greenland waters and along the Canadian coast. This was not a factor in the 1800's.

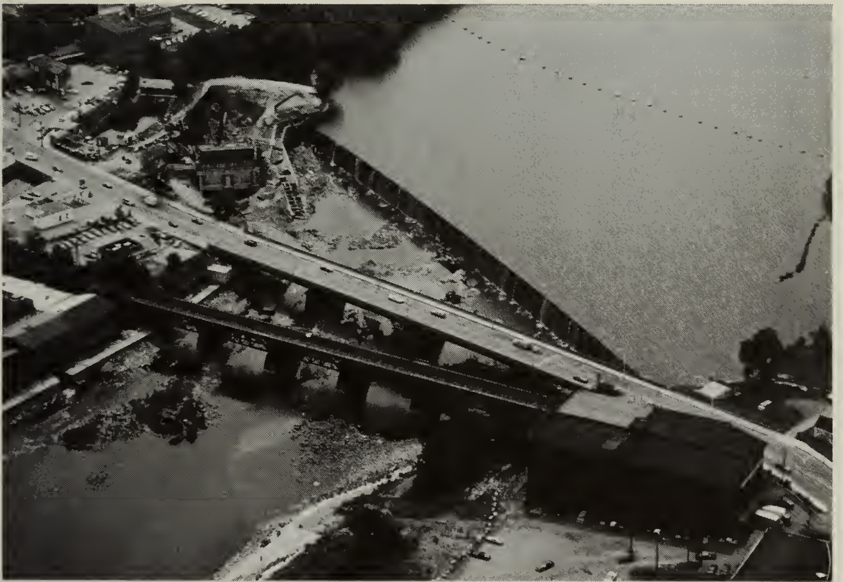

Figure 75. The present-day (1980) fishway at the Lawrence dam is being removed and a fish-elevator will be constructed. Rather than requiring only several months to complete this project, as was the normal case in the 1800's, several years will be required..

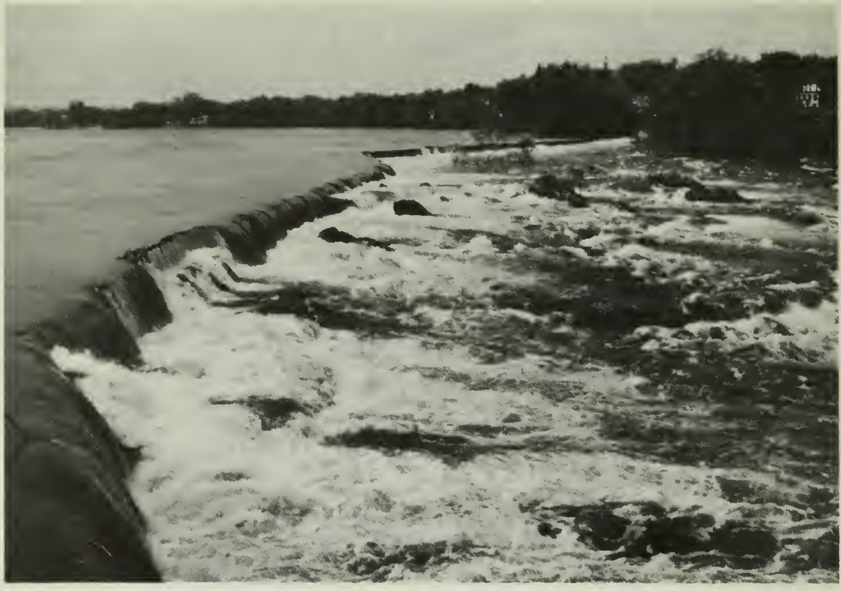

Figure 76. Fish passage facilities will be constructed during the early 1980's at the present-day (1979) Pawtucket Dam in Lowell.

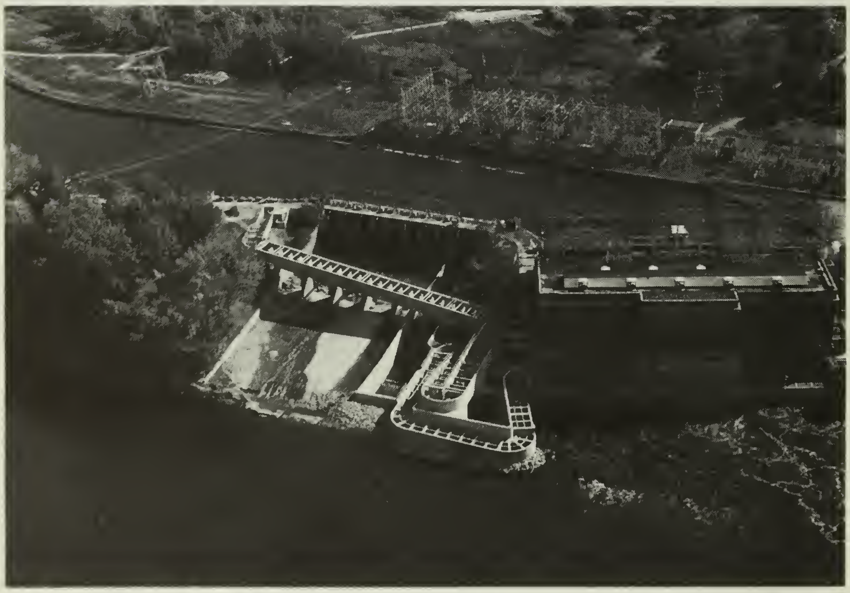

Figure 77. The complexity of providing fish passage can be readily seen in this 1980 picture of the structures recently constructed at the Turners Falls dam on the Connecticut River.

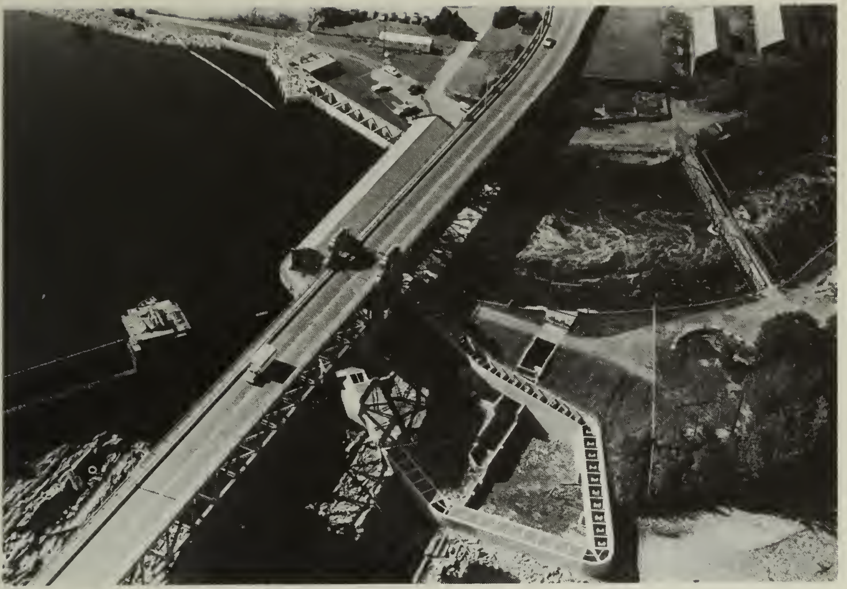

Figure 78. The Turners Falls dam project required the building of three fishways. It would have been difficult for those individuals working on restoration problems in the 1800's to visualize today's facilities.

Probably the most striking differences relate to the Atlantic salmon fish cultural program. The Atlantic salmon hatchery in the 1800's was essentially a hatching-house; a place where eggs were hatched and from which fry were liberated. The extended rearing of juvenile salmon was discussed in 1890; and termed inexpedient. Today, the Atlantic salmon hatchery is a complex, sophisticated, multi-million dollar structure, where the extended rearing of juvenile salmon is the principal activity. Most of the juvenile salmon are reared to the point when they are ready to migrate to the sea. In most cases this is two years. Few fry are released. In most cases, those that are released are destined for specific studies, or are a product of too many fish at the hatchery, making their release a necessity.

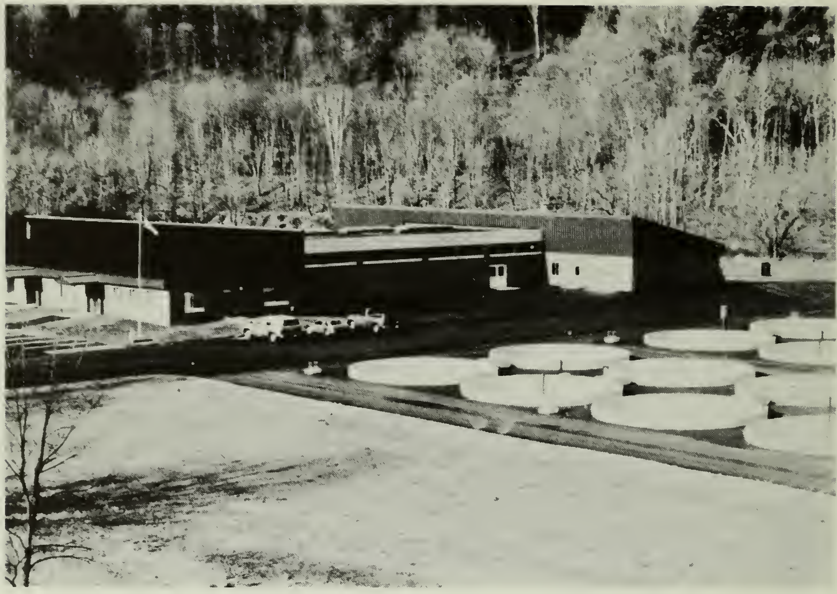

Figure 79. The White River National Fish Hatchery in Bethel, Vermont, the newest Federal facility for raising Atlantic salmon, is typical of today's modern hatchery.

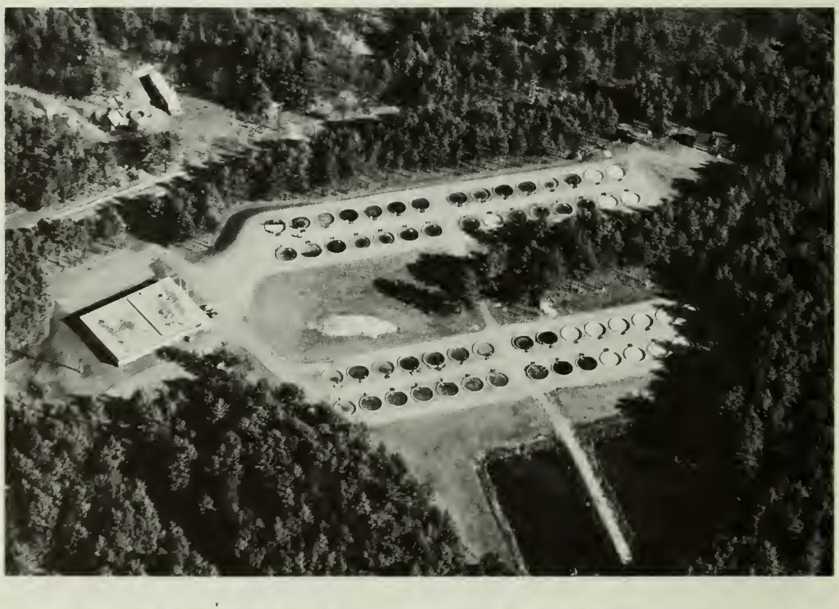

Figure 80. This aerial view of the Milford State Fish Hatchery in New Hampshire shows the facility in which many of the Atlantic salmon, destined for the Merrimack River, will be reared. (Photo courtesy of the New Hampshire Fish and Game Department.)

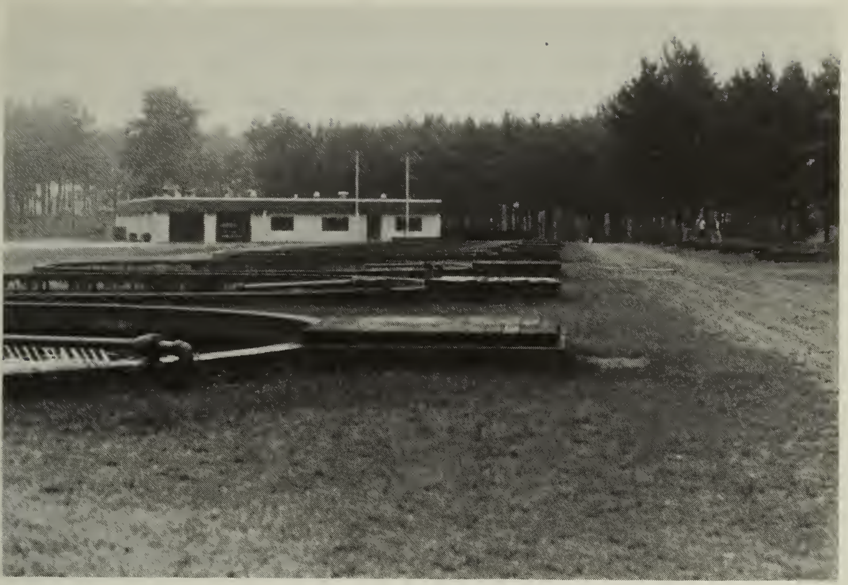

Figure 81. Although somewhat smaller, the Milford State Fish Hatchery resembles the White River National Fish Hatchery quite closely.

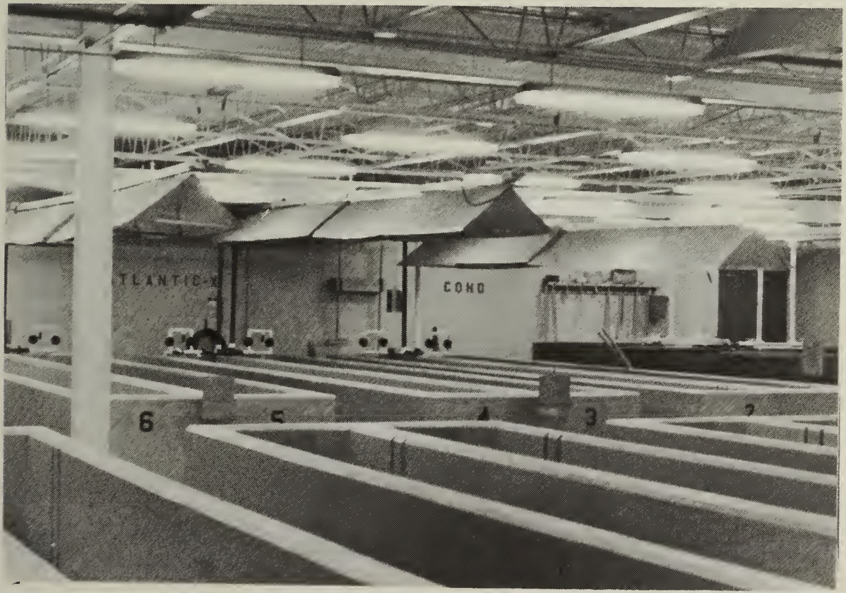

Figure 82. The inside of the Milford State Fish Hatchery resembles only to a minor degree the artist's drawing of the interior of the Plymouth Hatchery in the late 1800's.

In assessing the two restoration programs, whose beginnings are separated by just over a century; programs with the same ultimate goals, but differing methodologies, one cannot help but ask the question, "Can the Atlantic salmon be restored to the Merrimack River in the face of today's complexities?" Perhaps the answer to this question can be found in the very simple program of 100 years ago, and perhaps this time there will be no final chapter - tragedy will not again befall the king of fishes, the Atlantic salmon!

THE END

Epilogue

Epilogue

The Atlantic salmon restoration program, focusing on the Merrimack River, struggled for nearly a decade, but is now in 1980, gaining momentum. Long-range, formal plans have been developed, aimed at establishing a population of approximately 3,000 fish within the river during the next 15 years.

Two Federal fish hatcheries and one state facility will be producing Atlantic salmon smolts and fry for the river. Within the next five years over 200,000 salmon smolts will be released annually, primarily within the lower portion of the river's mainstem. Nearly one million fry will be distributed by helicopter, automobile, and on foot within the headwater areas and many of the tributaries annually, also.

The program cooperators are addressing the fish passage problems vigorously. The fish elevator at the Essex dam in Lawrence, will be operational in 1982. Plans have been generated that would assure fish passage at the Pawtucket dam in Lowell by 1984 at the latest. Discussions are now underway with the Public Service Company of New Hampshire, relative to providing fish passage at the Amoskeag, Hooksett, and Garvins Falls dams. There is hope that by the end of the 1980's, migratory fish will once again have access to the Sewalls Falls dam in Concord. Conceptual plans for fish passage will also be prepared for the Sewalls Falls dam and the Eastman Falls dam (the lowermost dam on the Pemigewasset River) River) during the period, 1980 through 1985.

The state agencies are now wrestling with the difficult but critical question of how best to manage the salmon resource. The lessons of the past will serve to guide the management agencies — the Atlantic salmon will require protection to some degree. Fortunately, this needed protection can be enforced today, whereas enforcement was nearly impossible 100 years ago.

Delicate negotiations are now underway relative to the commercial harvest of Atlantic salmon on the high seas. If these efforts are successful, the Atlantic salmon of Merrimack River origin may not have to face such an intensive commercial fishery as that of the last decade and consequently, more salmon would survive to return.

The real question, is probably not whether the Atlantic salmon *can* be restored, but *when*. There is every reason to believe that in 1992, three thousand adult salmon will be entering the Merrimack River; the same number that was estimated to have returned exactly 100 years ago!

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48. .... 1894. Public Document No. 25. Boston, Massachusetts.

49. .... 1895. Public Document No. 25. Boston, Massachusetts.

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Appendices

Appendix I

HISTORICAL PICTURES RELATING TO THE ATLANTIC SALMON IN THE LATE 1800'S AND EARLY 1900'S

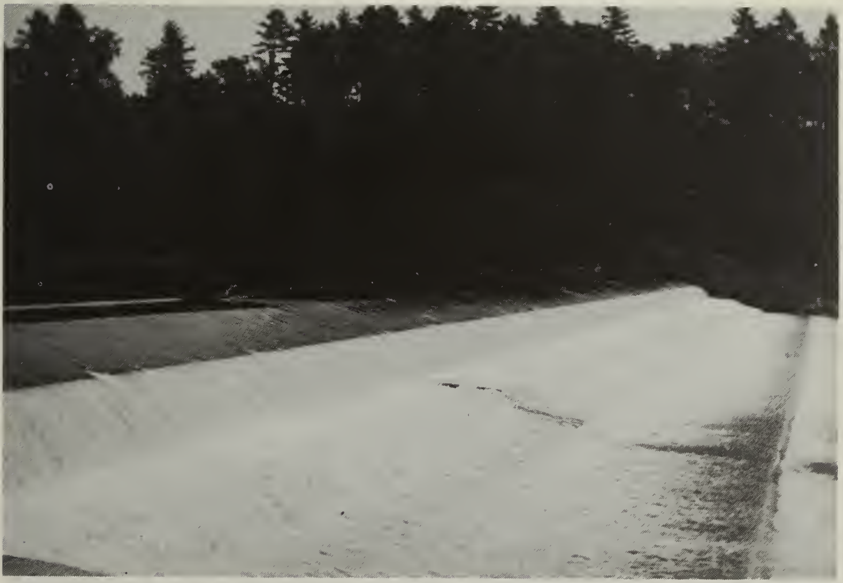

Figure 83. The Sewalls Falls dam, looking from the west side of the Merrimack River, was passing a large volume of water. It would seem that salmon might have been able to surmount this barrier at certain periods without the aid of a fishway. Circa 1895.

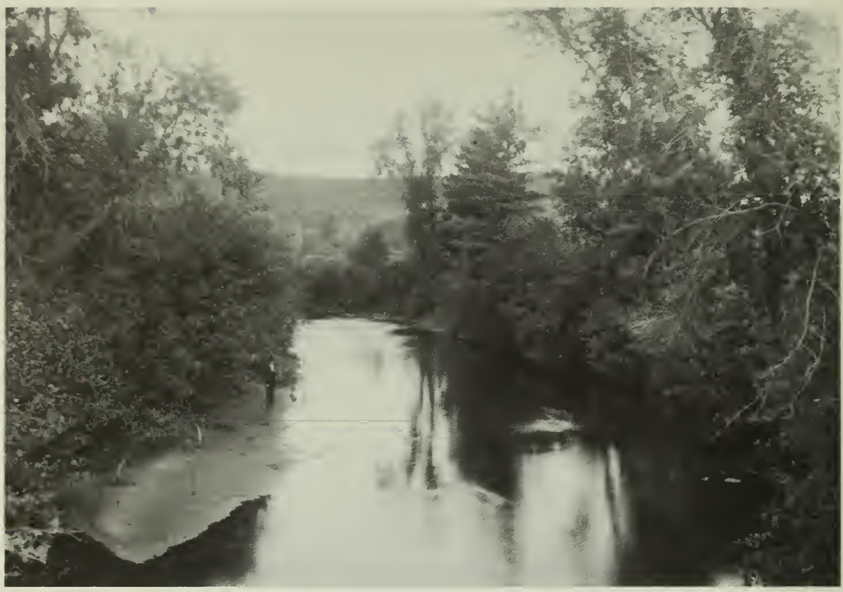

Figure 84. The Soucook River, frequented by salmon in the 1890's, is a rather tranquil setting here in 1895.

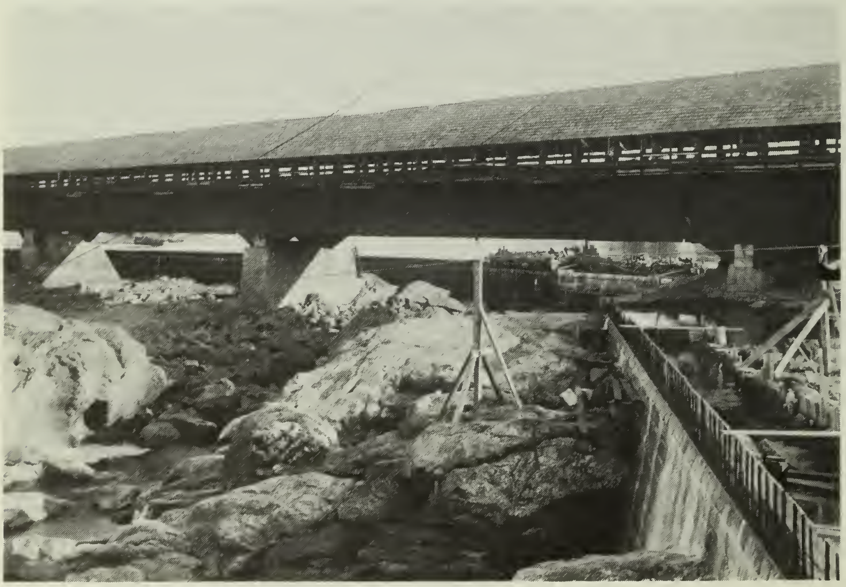

Figure 85. Construction work in progress is shown in this photo which was taken below the Amoskeag dam in Manchester in 1895.

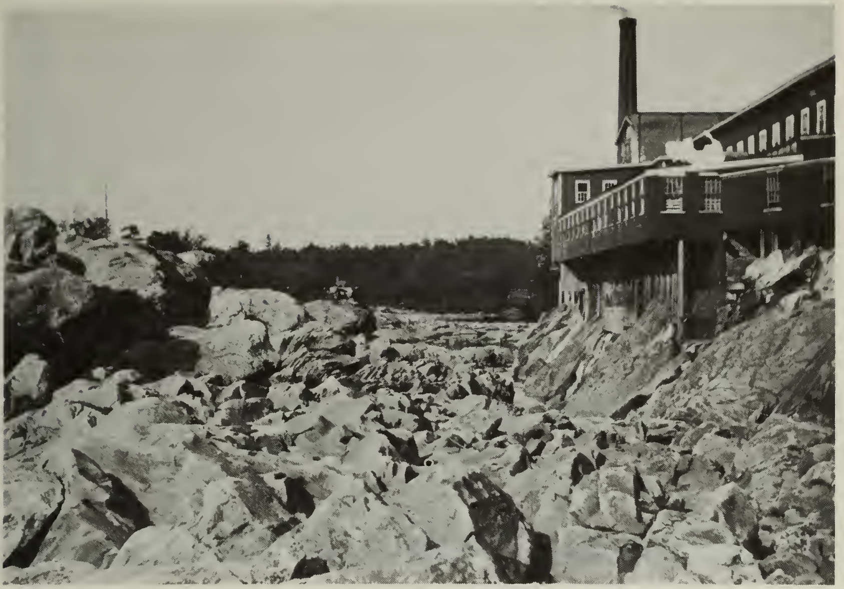

Figure 86. The river bed below the Amoskeag dam was nearly devoid of water in this scene. Water may have been passed around this area by the canal system. Circa 1896.

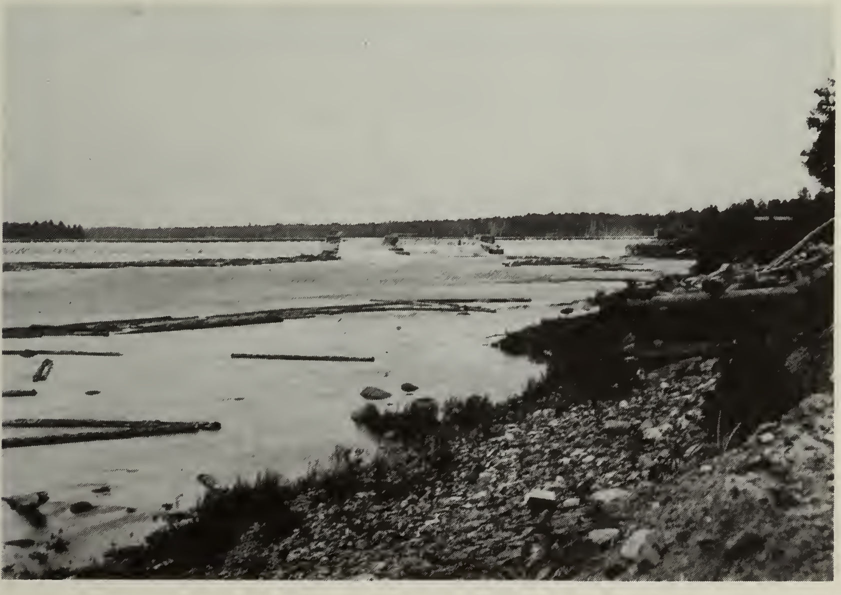

Figure 87. The dam at Montague on the Connecticut River was one of the first obstacles to the Atlantic salmon. July of 1896.

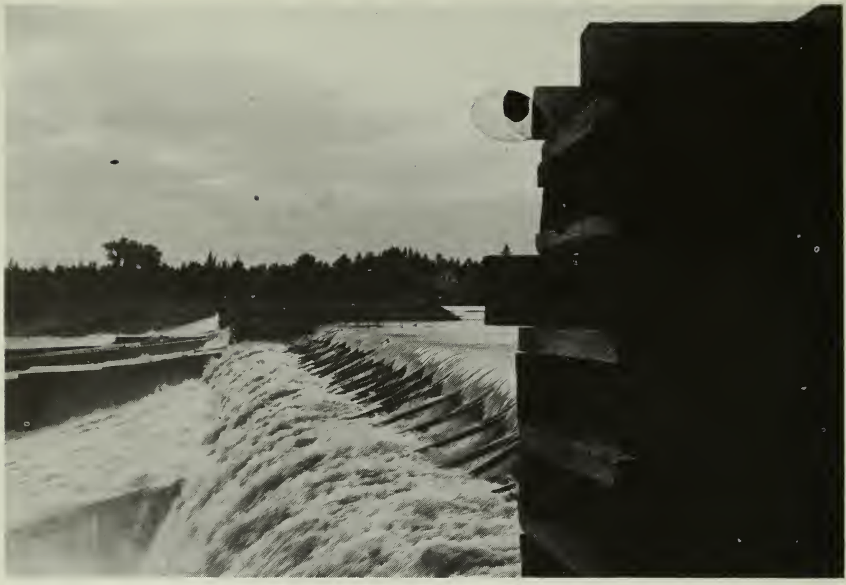

Figure 88. The Montague dam, looking from the east to the west, was passing a considerable amount of water on this July day in 1896.

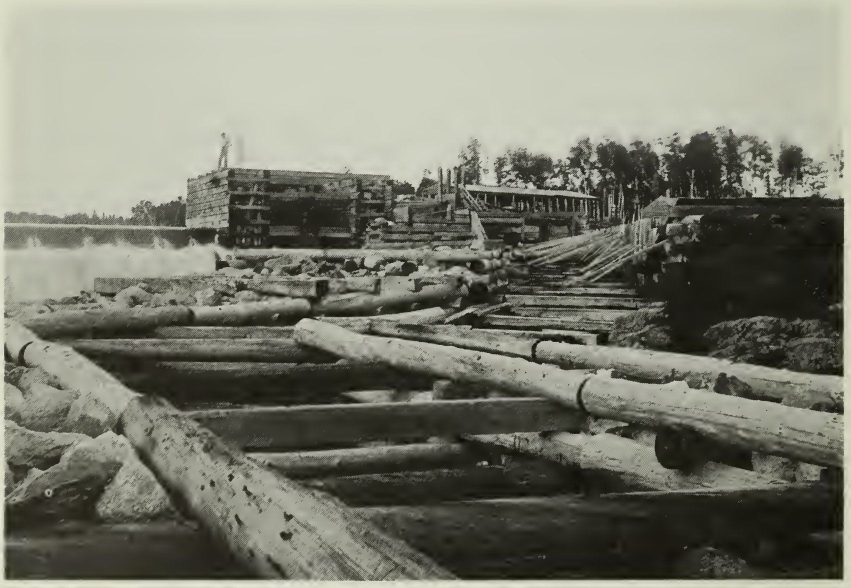

Figure 89. Although a fishway existed at the Montague dam (July 1896), it probably never passed any salmon.

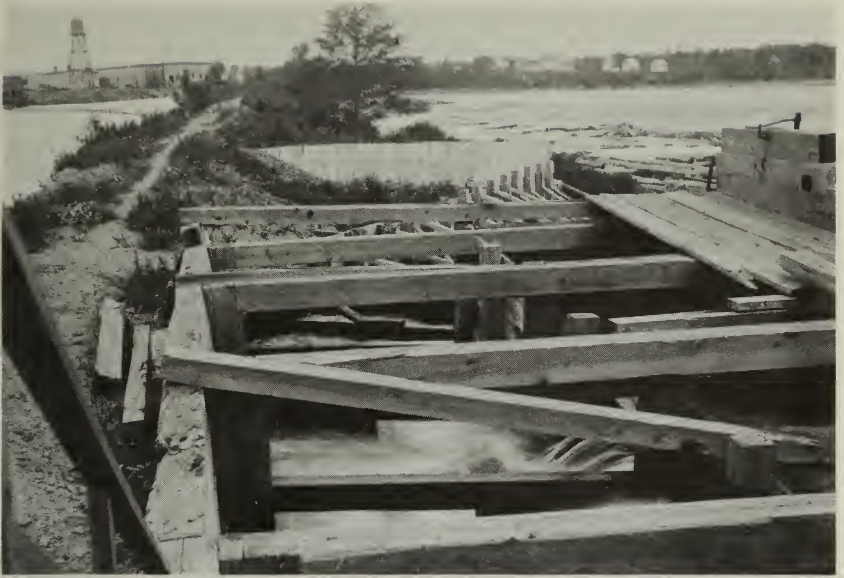

Figure 90. The fishway at Montague dam was an extensive wooden structure. July 1896.

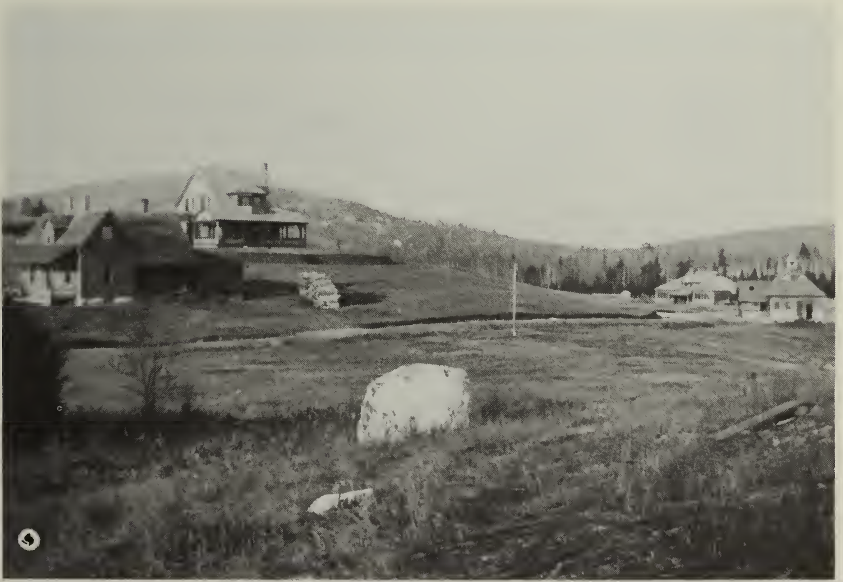

Figure 91. The Green Lake Hatchery in Maine, a sub-station of Craig Brook, is shown in this 1894 photo.

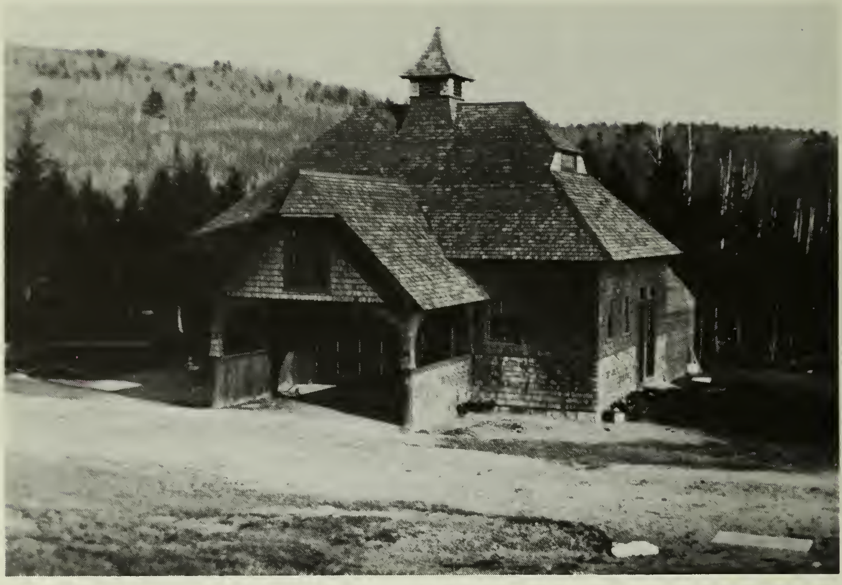

Figure 92. This close-up of one of the buildings at the Green Lake Hatchery (note the building in the extreme right of the previous photo) displays some of the interesting architecture. Circa 1890's.

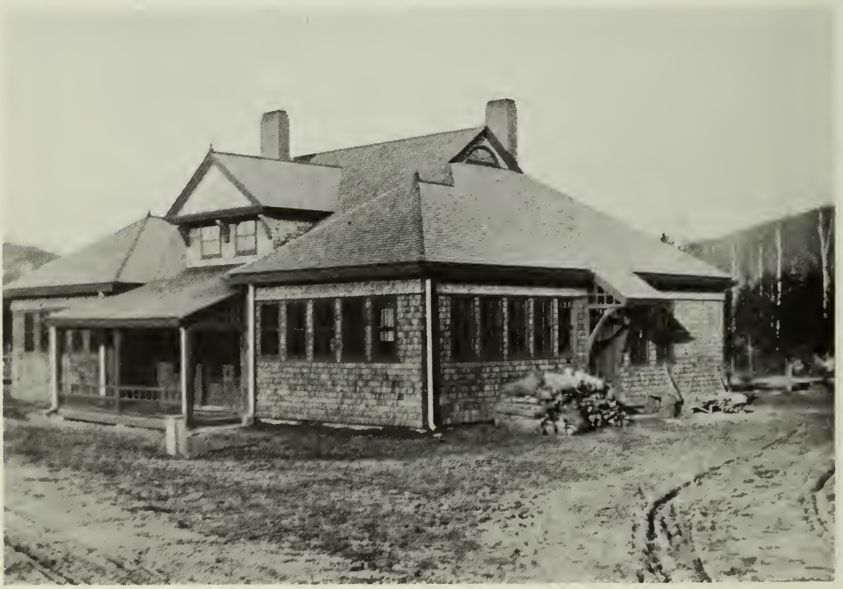

Figure 93. Another building at the Green Lake Hatchery is shown in this photo. Circa 1890's.

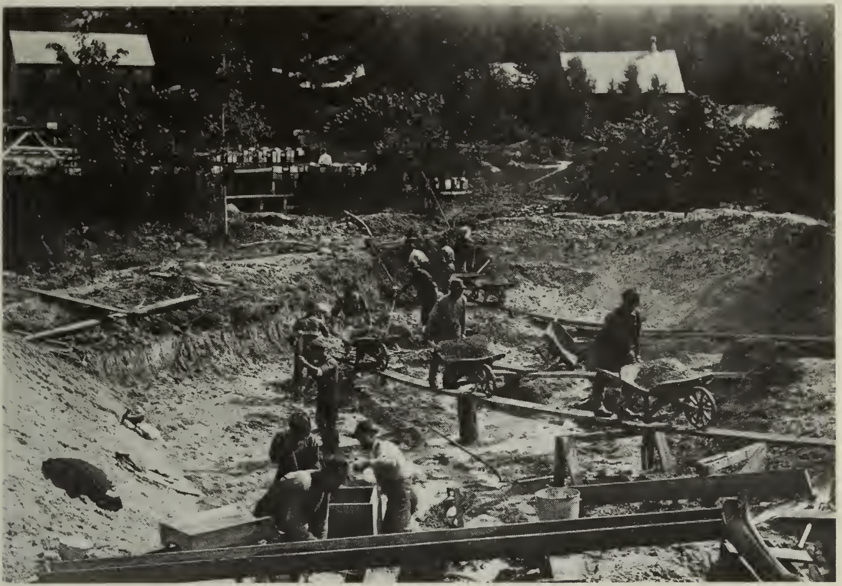

Figure 94. One of the ponds at the Craig Brook National Fish Hatchery was under construction during September of 1896.

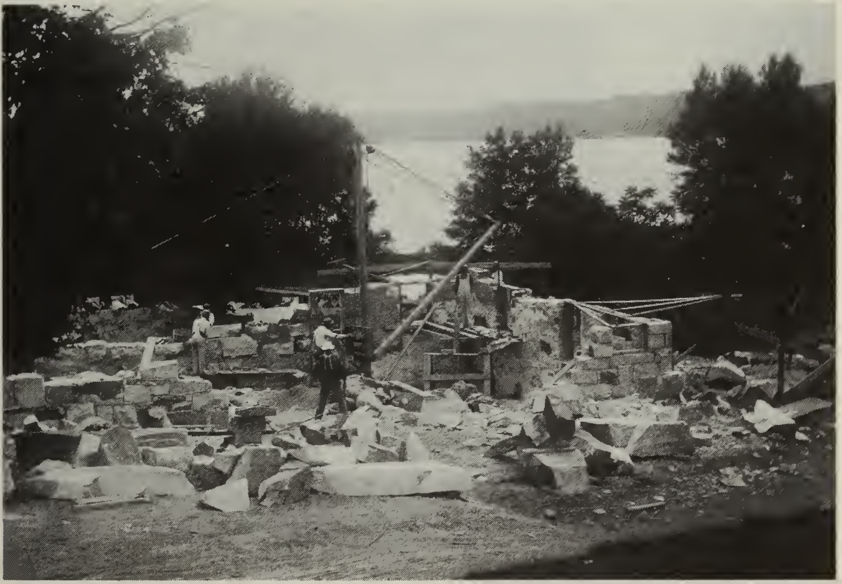

Figure 95. This construction which took place in 1906 resulted in a 'new' Craig Brook station.

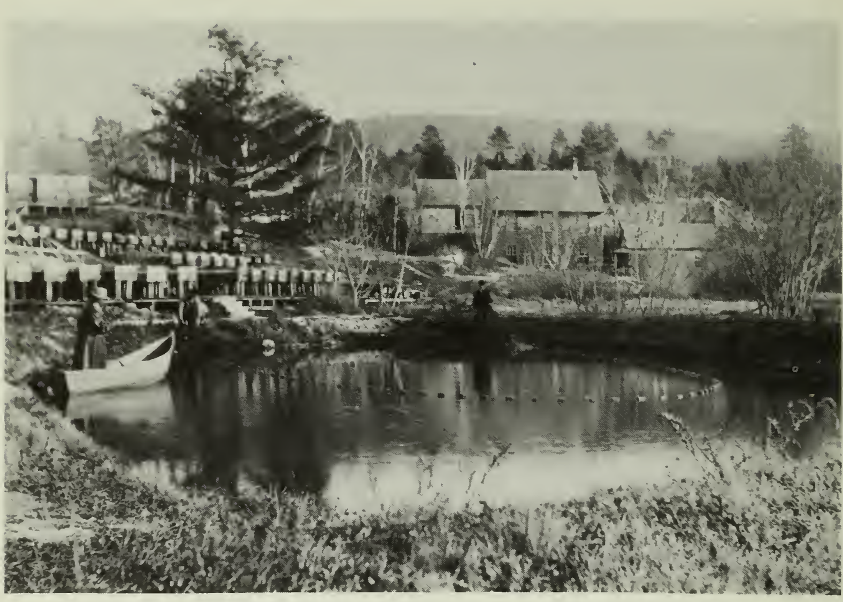

Figure 96. By seining, Atlantic salmon were captured in this holding pond at Craig Brook in November of 1897.

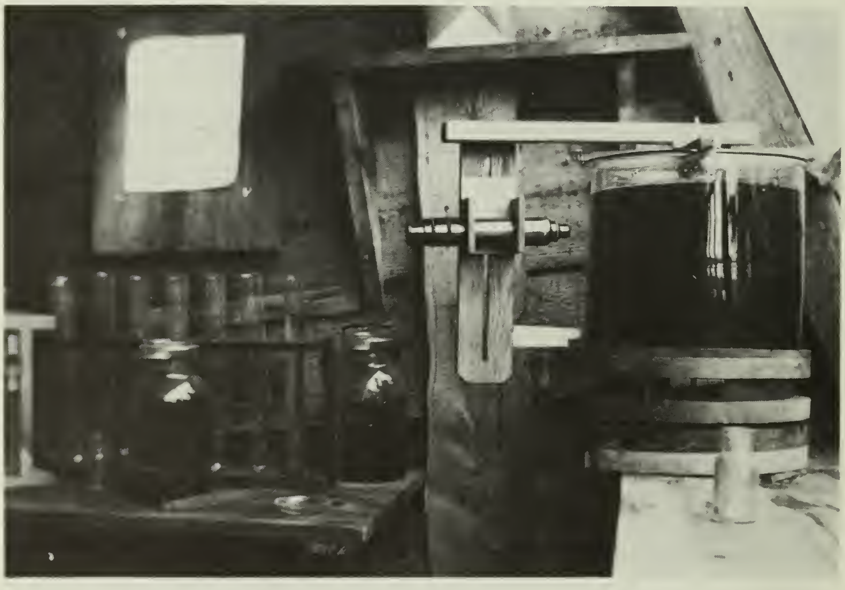

Figure 97. The interior of the egg house (spawning shed) at the Craig Brook station shows an apparatus we are not accustomed to today. The round container contains a chemical utilized to control the growth of fungus on the salmon eggs. Circa 1890's.

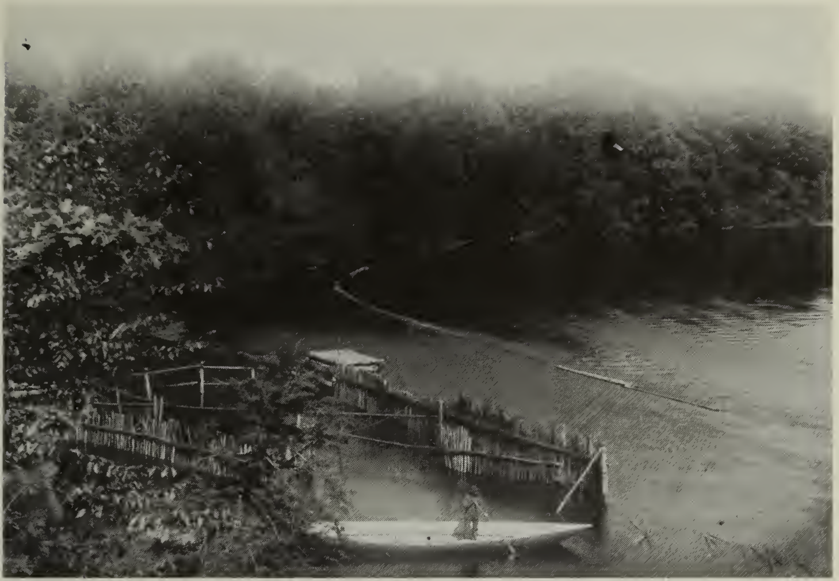

Figure 98. This picture of a salmon weir near Hunt Logan on the Penobscot River was taken in August of 1900.

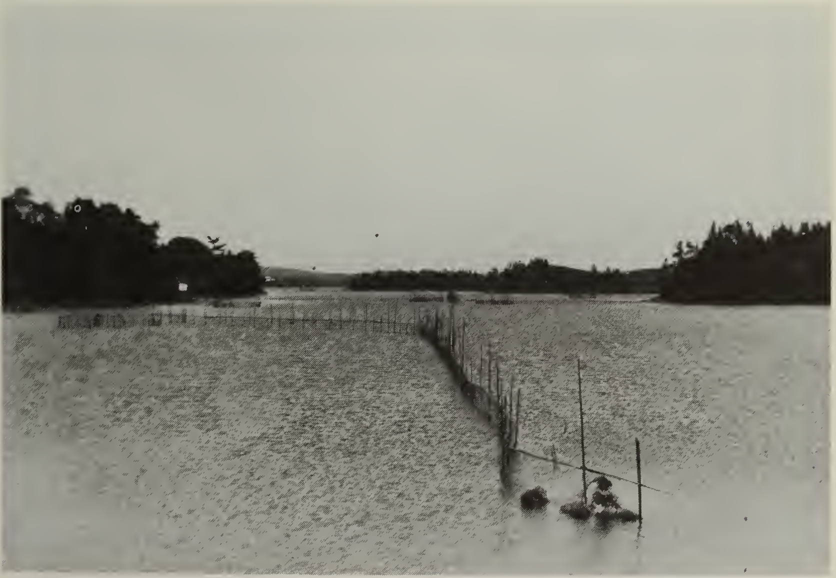

Figure 99. Another salmon weir on the Eastern River near Orland, Maine is shown here. Circa 1890's.

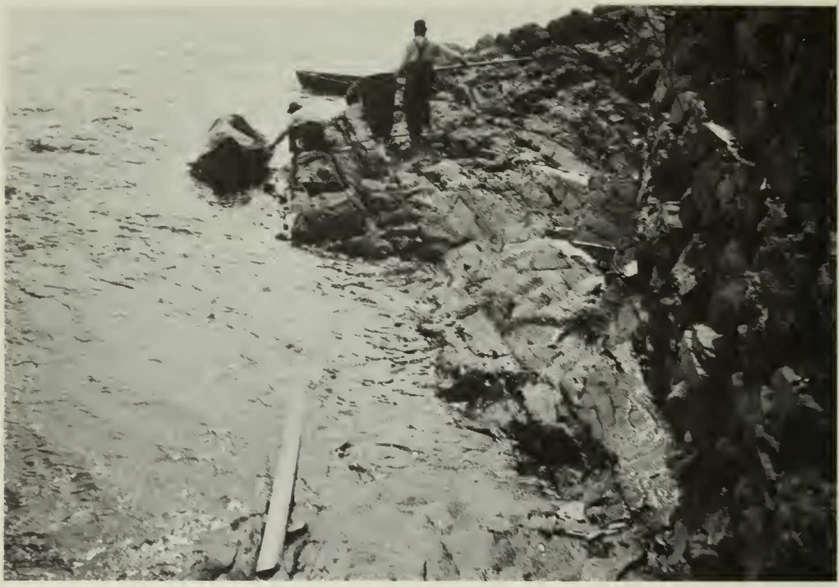

Figure 100. Several salmon cars (one is evidently full of salmon) were being walked up the shoreline of the Penobscot River during the 1890's.

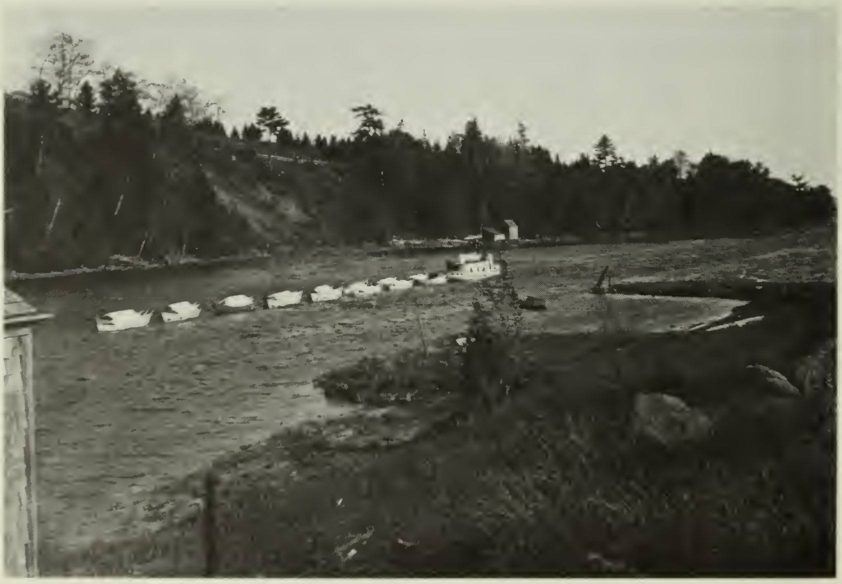

Figure 101. The steamer, Agnes, property of the United States Fish and Fisheries Commission, has a number of salmon cars in tow. Circa 1890's.

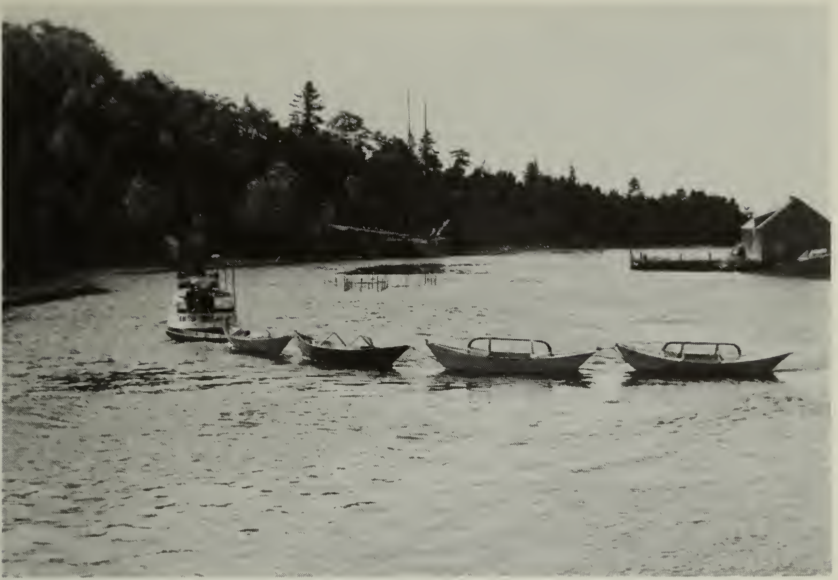

Figure 102. The steamer, Agnes, has four empty salmon cars in tow near Orland, Maine. Circa 1890's.

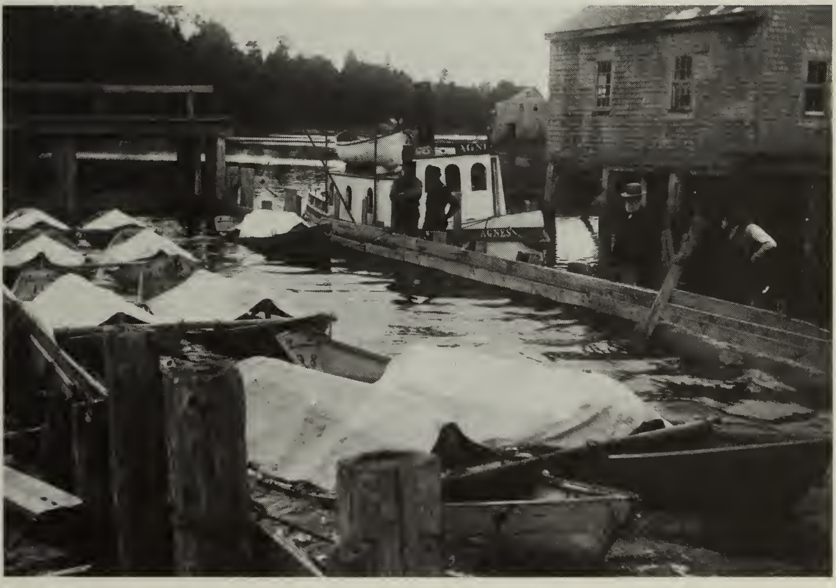

Figure 103. In June of 1899, nine loaded salmon cars were in the lock at Orland, Maine.

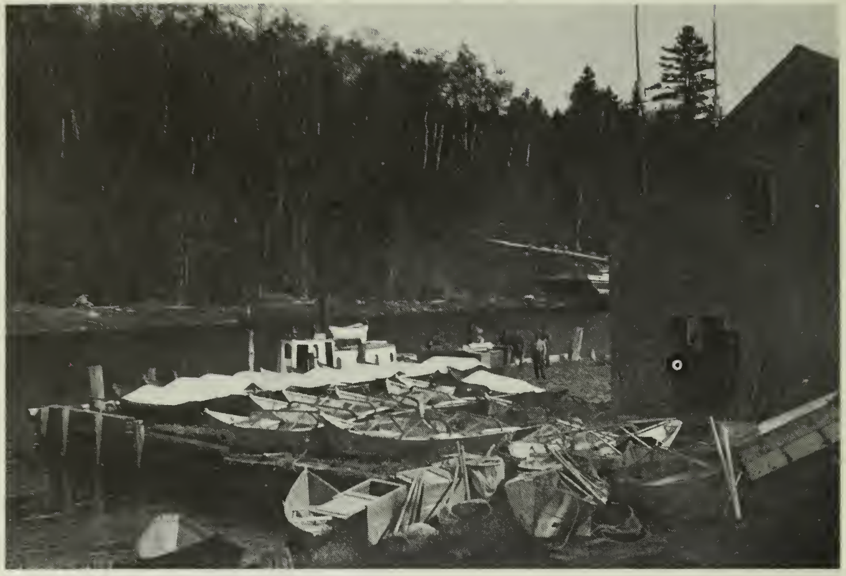

Figure 104. A number of salmon cars were moored to the wharf at Orland, Maine in preparation for later use. May 1896.

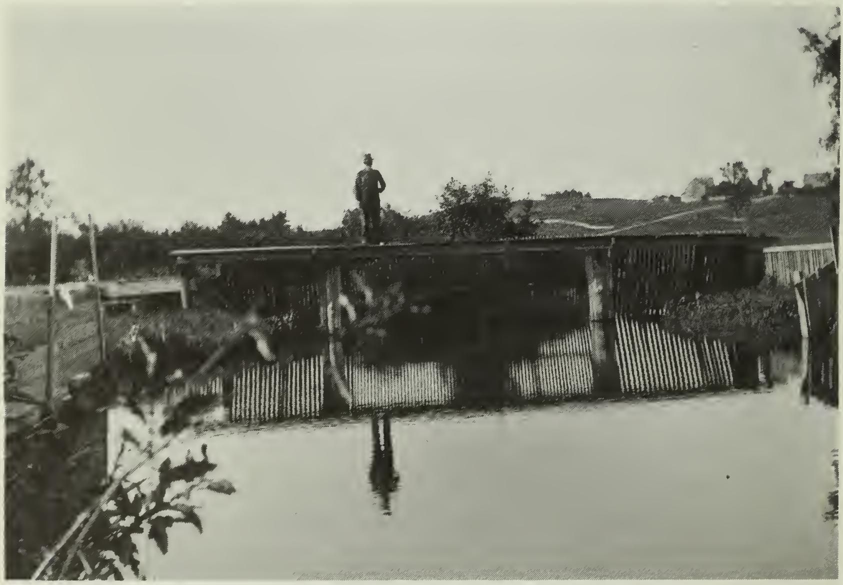

Figure 105. The upper barrier at Dead River, part of an adult salmon holding facility near the Craig Brook station is pictured here in the mid-1890's.

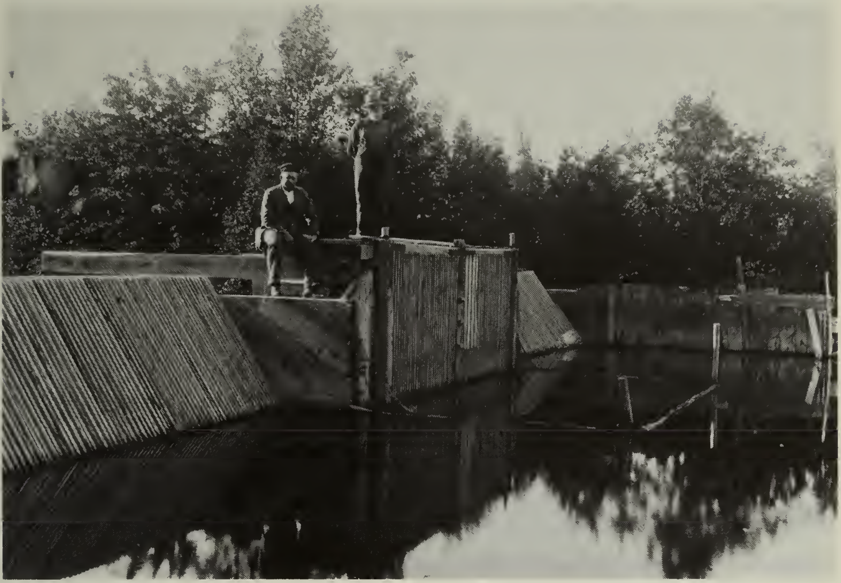

Figure 106. Two hatchery men are shown on the lower barrier at the Dead River adult salmon holding facility. Circa 1895.

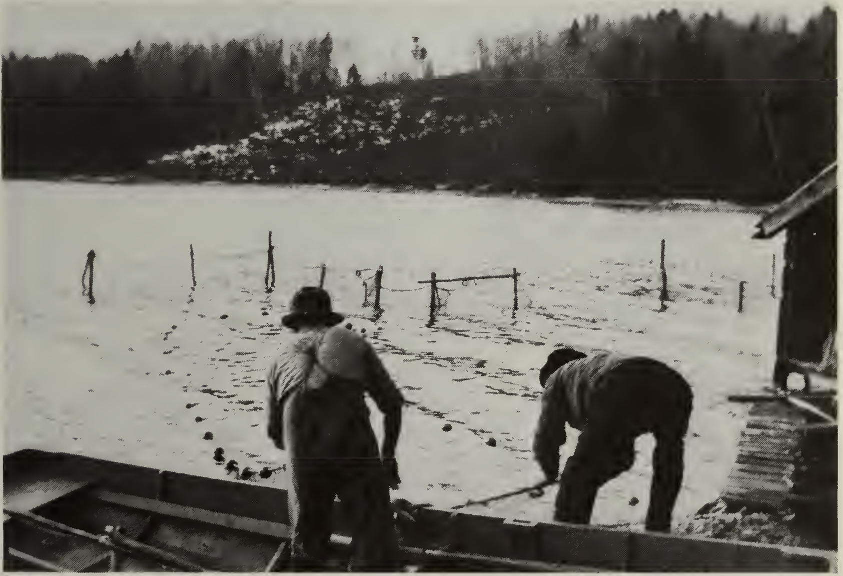

Figure 107. Two hatchery men are netting adult salmon, in preparation for egg-taking, at the holding pens near the mouth of Dead River. Circa 1890's.

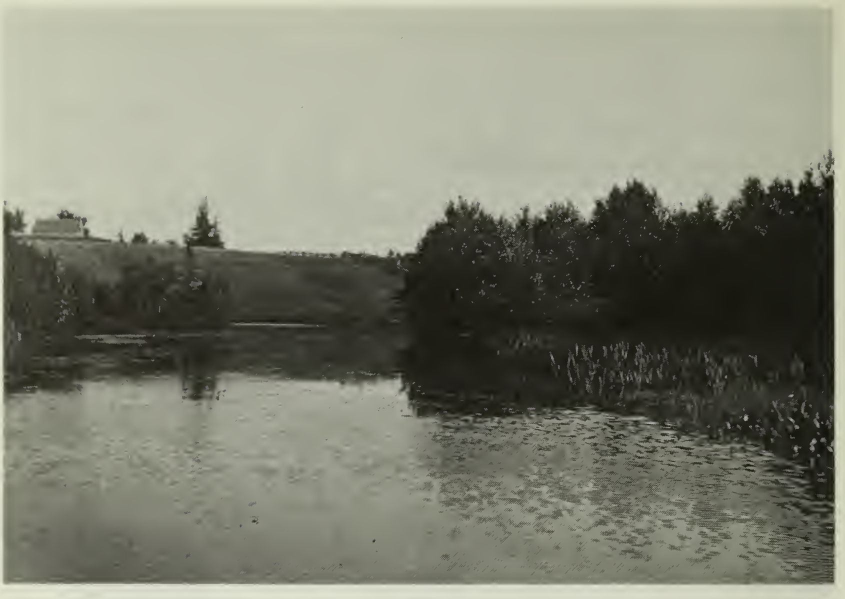

Figure 108. Soper's Pool was the label on this phtograph which was taken near the Dead River in the late 1800's.

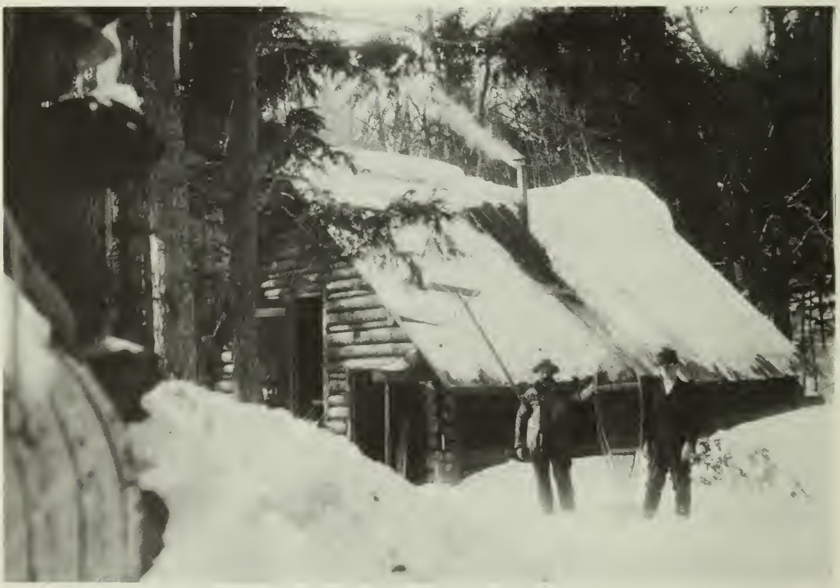

Figure 109. Heavy snow was being removed from this log cabin which was situated on the East Branch of the Penobscot River. Atlantic salmon eggs were placed into a spring that was situated within the building. Upon hatching, the young salmon were transferred to the river. Circa 1890's.

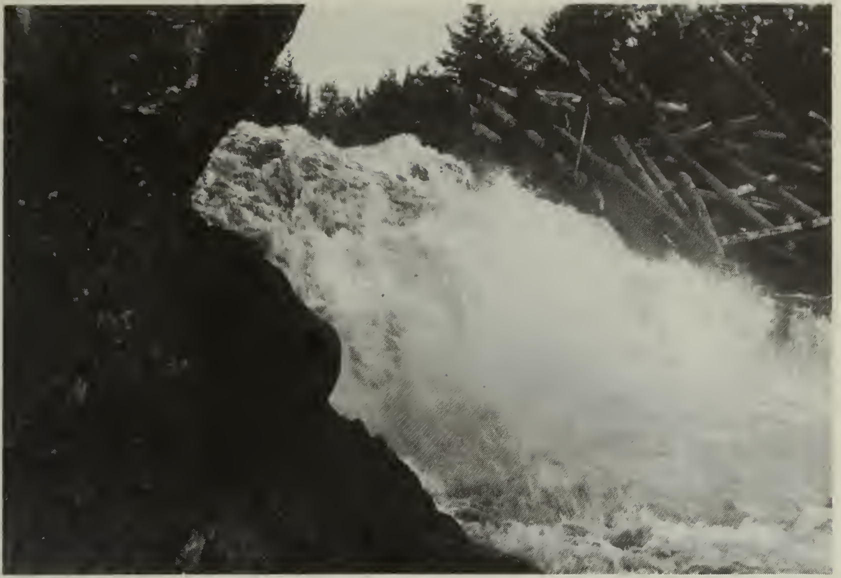

Figure 110. This area on the East Branch of the Penobscot River was labeled the Grand Pitch. Circa 1890's.

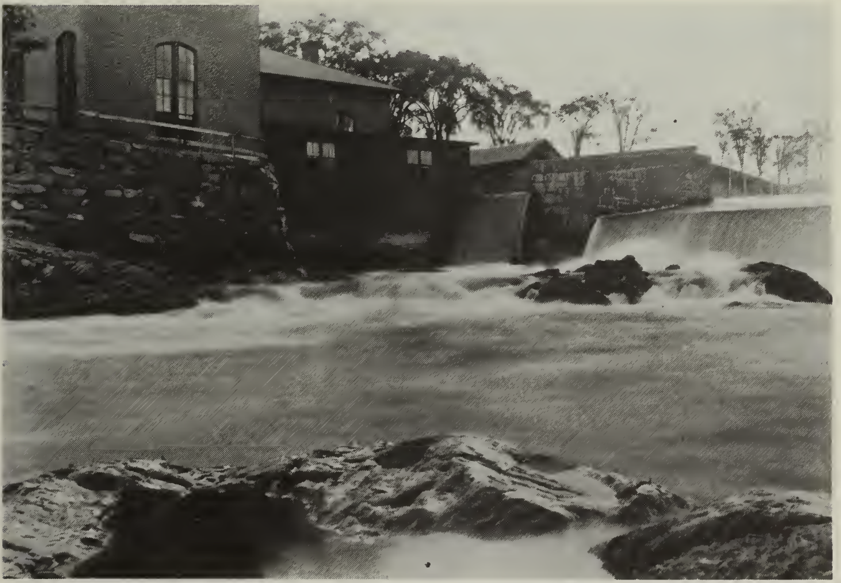

Figure 111. The wheelhouse at the Water Works in Bangor, Maine is pictured here in the late 1890's.

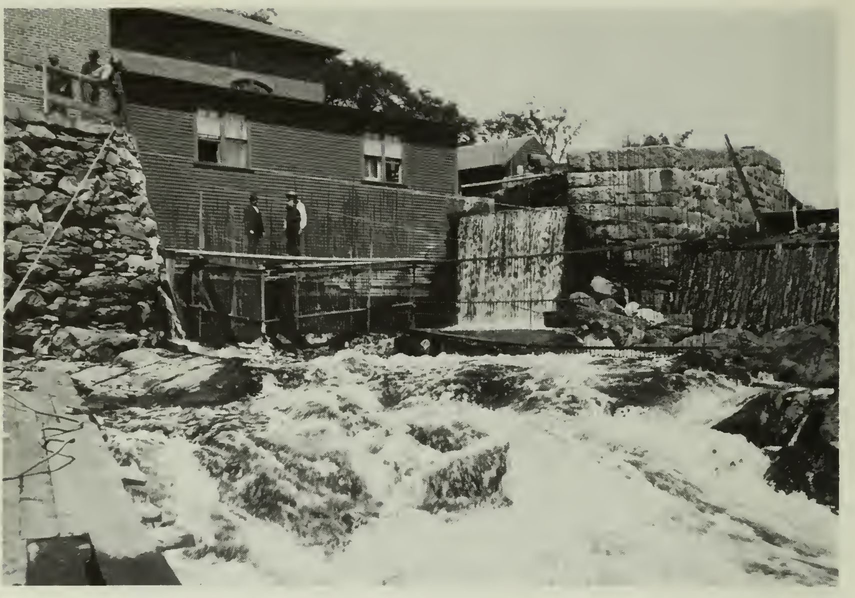

Figure 112. This view of the salmon trap at the Bangor dam was taken in August of 1896 The gentleman standing to the right on the platform is Charles G. Atkins.

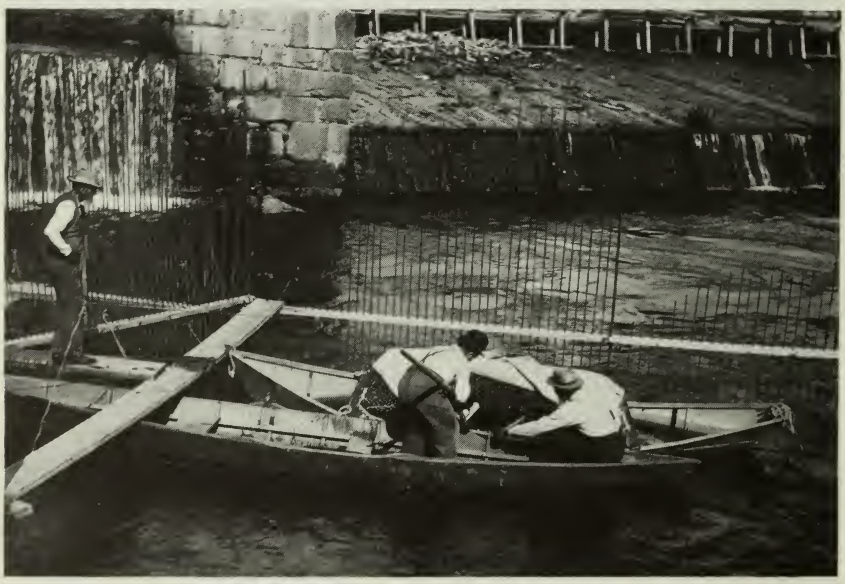

Figure 113. Charles Atkins is over seeing the operation at the Bangor salmon trap. Atkins is the bearded gentleman standing just to the left of the men in the boat. Circa 1896.

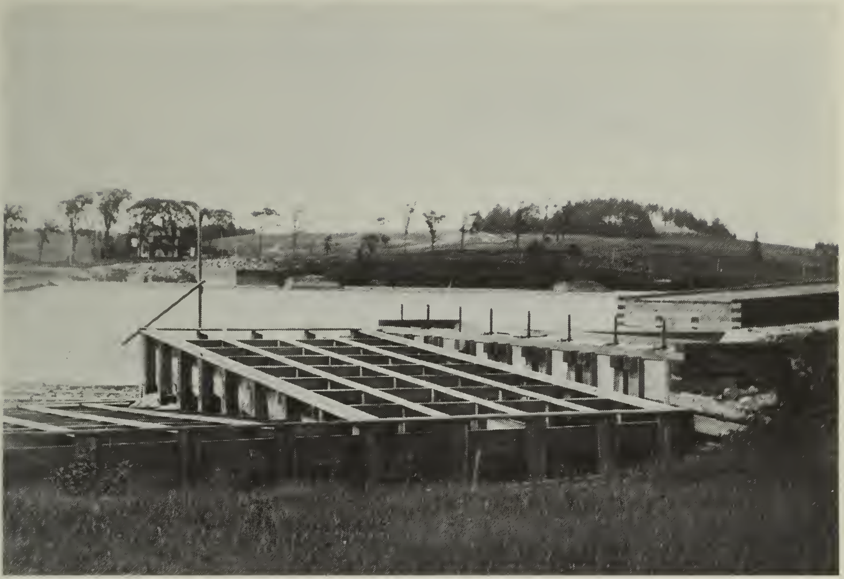

Figure 114. The fishway at the Bangor dam (July of 1896) was located on the east side of the Penobscot River.

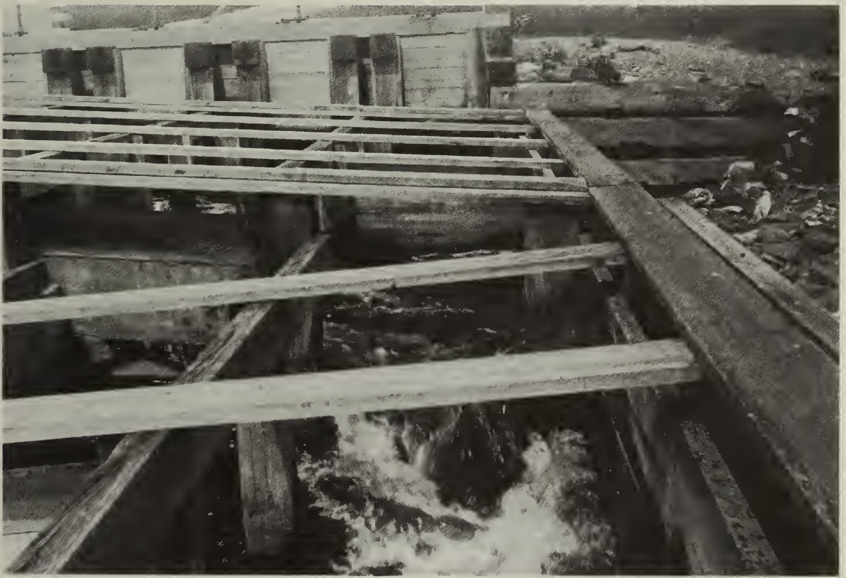

Figure 115. The Bangor dam fishway is shown in operation during the summer of 1896

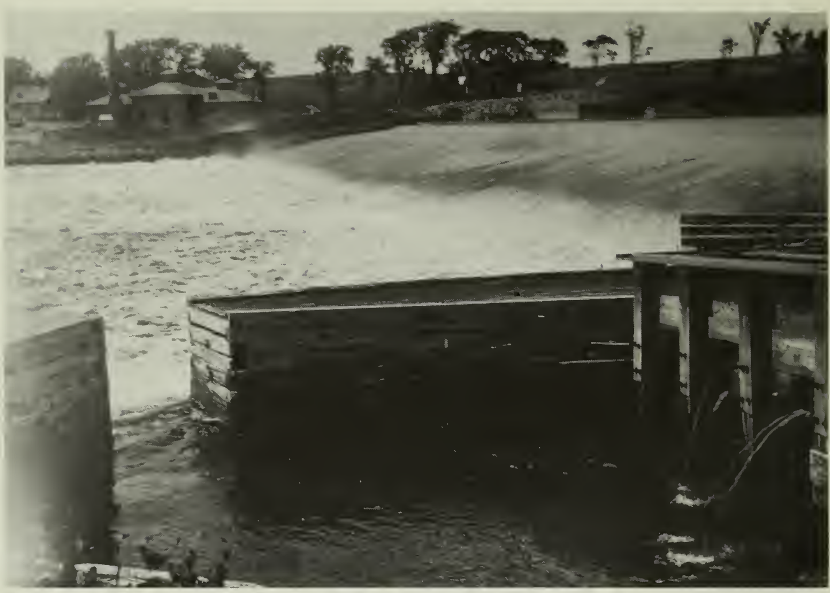

Figure 116. The entrance to the Bangor fishway is shown in this 1896 photo.

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Appendix II

THE HISTORICAL ATLANTIC SALMON POPULATION THAT INHABITED THE MERRIMACK RIVER BASIN

The estimated number of adult salmon that inhabited the Merrimack River in pre-colonial times is based on the amount of habitat that was accessible and utilized by the salmon, the smolt production that could have been generated, and the survival of the smolts during their ocean residency. The following table presents the development of the estimate:

HISTORICAL ATLANTIC SALMON POPULATION ESTIMATE

Tributary	**Amount of Habitat** (100 Sq. Yd. Units)	**Estimated Smolt Production** (Based on 4 Smolts per Unit)	**Estimated No. of Adults Produced** (Based on a 5% Marine Survival of the Smolts)
Concord River	1,500	6,000	300
Nashua River	2,500	10,000	500
Souhegan River	2,700	10,800	540
Piscataquog River	5,500	22,000	1,100
Suncook River	1,800	7,200	360
Soucook River	3,400	13,600	680
Contoocook River	10,000	40,000	2,000
Pemigewasset River (mainstem)	16,000	64,000	3,200
Baker River	6,400	25,600	1,280
Beebe River	2,200	8,800	440
Mad River	4,600	18,400	920
East Branch of Pemigewasset R.	7,700	30,800	1,540
Merrimack River (mainstem)	21,100	84,400	4,220
	85,400	341,600	17,880

The estimated population, 17,880 fish, probably fluctuated, which is normal even today. A 50% fluctuation would not have been uncommon. Thus, the population estimate would range from a low of 8,940 to a high of 26,820.

Appendix III

PRECIPITATION RECORDS[a] FOR CONCORD, NEW HAMPSHIRE 1873 - 1882

	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882
JAN.	4.41	2.98	3.06	2.19	1.98	4.11	2.43	4.23	3.22	3.55
FEB.	1.98	3.17	2.38	5.55	0.40	4.18	2.89	2.46	3.52	3.90
MAR.	2.61	0.69	4.21	7.86	5.21	2.28	2.77	1.28	3.64	2.67
APR.	1.95	4.45	3.17	2.28	3.26	6.70	2.98	2.71	0.91	1.05
MAY	2.15	4.19	2.77	3.22	2.98	1.86	4.51	1.63	3.28	4.07
JUNE	0.89	4.74	3.97	4.89	2.63	5.10	4.76	1.33	3.34	3.98
JULY	4.08	7.54	2.43	4.73	4.77	1.84	4.29	3.55	4.38	1.73
AUG.	1.85	1.95	5.31	.42	4.37	4.06	4.39	1.47	1.25	0.35
SEPT.	4.06	2.40	2.92	3.82	0.85	0.71	3.28	3.12	3.52	7.22
OCT.	6.05	1.37	6.17	.95	7.62	4.09	0.79	3.98	2.96	1.41
NOV.	2.90	2.33	3.12	2.56	6.20	5.76	4.02	2.01	3.19	1.09
DEC.	3.12	0.83	1.00	3.87	0.82	6.41	3.77	2.26	5.84	1.70
	36.05	35.64	40.51	42.34	41.09	47.10	40.88	30.03	39.05	32.72

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a) Records are in inches. Data provided by the publication, History of Concord, N.H., Jan. 1896, Volume 1, Prepared by James O. Lyford.

Appendix III

PRECIPITATION RECORDS[a] FOR CONCORD, NEW HAMPSHIRE 1883 - 1892

	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892
JAN.	1.75	4.08	4.45	4.92	3.35	4.93	3.82	2.88	5.71	3.98
FEB.	2.25	5.50	3.50	4.27	4.86	3.69	1.78	4.20	3.54	1.70
MAR.	1.39	4.31	0.88	3.27	3.04	4.92	2.51	5.69	4.19	2.00
APR.	2.36	3.45	2.54	1.66	2.94	2.84	2.09	1.88	2.41	0.76
MAY	3.04	3.07	2.18	2.22	2.33	4.98	2.46	5.05	2.34	6.24
JUNE	2.04	0.93	4.85	2.48	4.56	2.57	4.21	2.56	3.32	3.00
JULY	5.80	2.14	2.15	2.56	7.84	0.96	5.63	3.98	3.34	2.50
AUG.	1.37	3.62	5.32	3.49	7.68	3.67	1.57	3.56	2.95	9.00
SEPT.	1.96	0.76	0.96	4.25	0.82	10.97	3.86	4.65	2.09	1.98
OCT.	3.67	1.99	3.63	2.66	1.71	5.63	4.21	7.76	2.63	1.29
NOV.	1.87	2.77	3.65	3.81	3.70	4.15	4.98	1.49	1.73	4.33
DEC.	2.37	3.97	3.60	3.30	3.62	3.52	3.88	3.83	4.11	1.04
	29.87	36.59	37.71	38.89	46.45	52.33	41.00	47.53	38.36	37.82

a) Records are in inches. Data provided by the publication, History of Concord, N.H., Jan. 1896, Volume 1, Prepared by James O. Lyford.

Appendix IV

ATLANTIC SALMON POPULATION ESTIMATES DURING THE RESTORATION YEARS, 1866 THROUGH 1896

The estimated number of salmon comprising the runs generated during the restoration effort is based principally on the number of fry stocked or produced through natural reproduction in the Pemigewasset River system. The number of adults that were produced from specific fry population levels, relates directly to an earlier referenced paper by Raymond Dow, in which it was estimated that between 3.6 and 5.2 adults could be produced for every 1,000 fry stocked. Although I used Dow's work as my starting point, I chose to be more conservative and utilized an estimate of 1.8 adults produced per 1,000 fry released or produced.

It was relatively easy to determine the number of fry released, since the stocking records were available. These records, existing primarily within the Reports of the New Hampshire Fish and Game

Commission, were cross referenced with the egg-shipping records of the United States Fish and Fisheries Commission for accuracy. In order to calculate the number of fry that might have been produced through natural reproduction, it was necessary to estimate the number of adult salmon that, after entering the lower Merrimack River, would have reached the spawning grounds. My first assumption was that not all of the adult salmon would reach the spawning grounds. I then utilized the historical records regarding the river conditions, during a particular spring, summer, and fall. This information was compared with the rainfall observations at Concord, New Hampshire (Appendix III) during the same time period. When rainfall exceeded 40 inches during the year, I estimated that 80% of the salmon passing the Lawrence fishway reached the spawning grounds. When the rainfall exceeded 37 inches but was less than 40 inches, I estimate 60% of the fish reached the spawning grounds. When the rainfall exceeded 33 inches but not 37 inches, I estimated that only 50% of the fish would have reached the spawning grounds and when the rainfall fell below 33 inches, I estimated that 40% of the salmon would have reached the spawning grounds.

In order to determine the potential success of natural reproduction, the sexual composition of the adult salmon runs, as well as the fecundity of the female salmon had to be calculated. The records regarding the sex ratio of the fish captured at Livermore Falls during the restoration effort indicated that 40% of the fish were females. The fish captured at Livermore Falls averaged nearly 11 pounds, and produced nearly 700 eggs per pound of body weight. I therefore estimated that each female produced 8,000 eggs. It was then a simple mathematical procedure to calculate the potential egg deposition estimate for a particular run of salmon. The number of fry produced was conservatively estimated at 10% of the potential egg deposition. The number of fry produced through natural reproduction was, of course, in addition to any fry-plant made during that particular year.

The important question is, ‘How many adult salmon actually returned to the Merrimack River?’ As indicated earlier, I utilized the figure of 1.8 adults produced for each 1,000 fry released or produced naturally. It is important to realize that the fry produced smolts which migrated from the river and generated the adult returns. This sequence of events is very general, and does not delineate the complexity that occurs today and that probably occurred historically.

It is quite likely that not all of the fry produced smolts of the same age. I have made the assumption that 80% of the fry produced 2-year smolts and 20% produced 3-year smolts. I have further assumed that these smolts, the 2- and 3-year-olds, would have generated adult runs in different years. It was also assumed that the adults runs would have been composed of grilse (fish having spent one summer and winter at sea), two-sea-year fish (fish having spent two summers and two winters at sea), and three-sea-year fish (fish having spent three summers and three winters at sea). I did not address the issue of repeat spawners; those individuals that spawned, returned to the sea, then after a period of time returned to the river to spawn again. Thus, in any one adult run four different year-classes would have been represented. The grilse component related to the fry produced or released three and four years previously. The two-sea-year fish related to fry released or produced four and five years previously, and the three-sea-year fish represented fry that had been released or produced five and six years previously. Thus, an adult run would have been composed of 3,4,5, and 6-year old fish.

The initial population estimate (size of a particular adult run) was calculated by determining the number of fry that generated the run, and multiplying that figure by 0.0018 (1.8 adults per 1,000 fry). The final population estimate was calculated by multiplying the initial estimate by a correction factor. The correction factor was based on the number of fish counted at the Lawrence fishway. The following correction factors were used:

No. Adult Salmon counted at the Lawrence Fishway	Corresponding Correction Factor
1-15	0.5
16-43	1.0
44-71	1.5
72-99	2.0

The grilse, two-sea-year, and three-sea-year salmon components of a particular run were based on the following ratio:

5 grilse: 86 two-sea-year: 9 three-sea-year

This ratio was directly related to observed weights of the salmon from 1877 through 1885. Fish less than eight pounds were considered to be grilse. Fish weighing from 8 to 16 pounds were considered to be two-sea-year fish, and fish exceeding 16 pounds were placed into the three-sea-year group.

The Atlantic salmon population estimates are presented in the following table. It is estimated that 22,636 salmon returned to the Merrimack River from 1876-1898. Interestingly, this estimate is quite similar to the estimate (20,136) derived during the effort itself. Obviously, there is a great deal of speculation in the derivation of my estimates. However, it is founded on reasonable assumptions and is considered to be totally realistic.

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ATLANTIC SALMON POPULATION ESTIMATES FOR THE MERRIMACK RIVER, 1867 - 1898

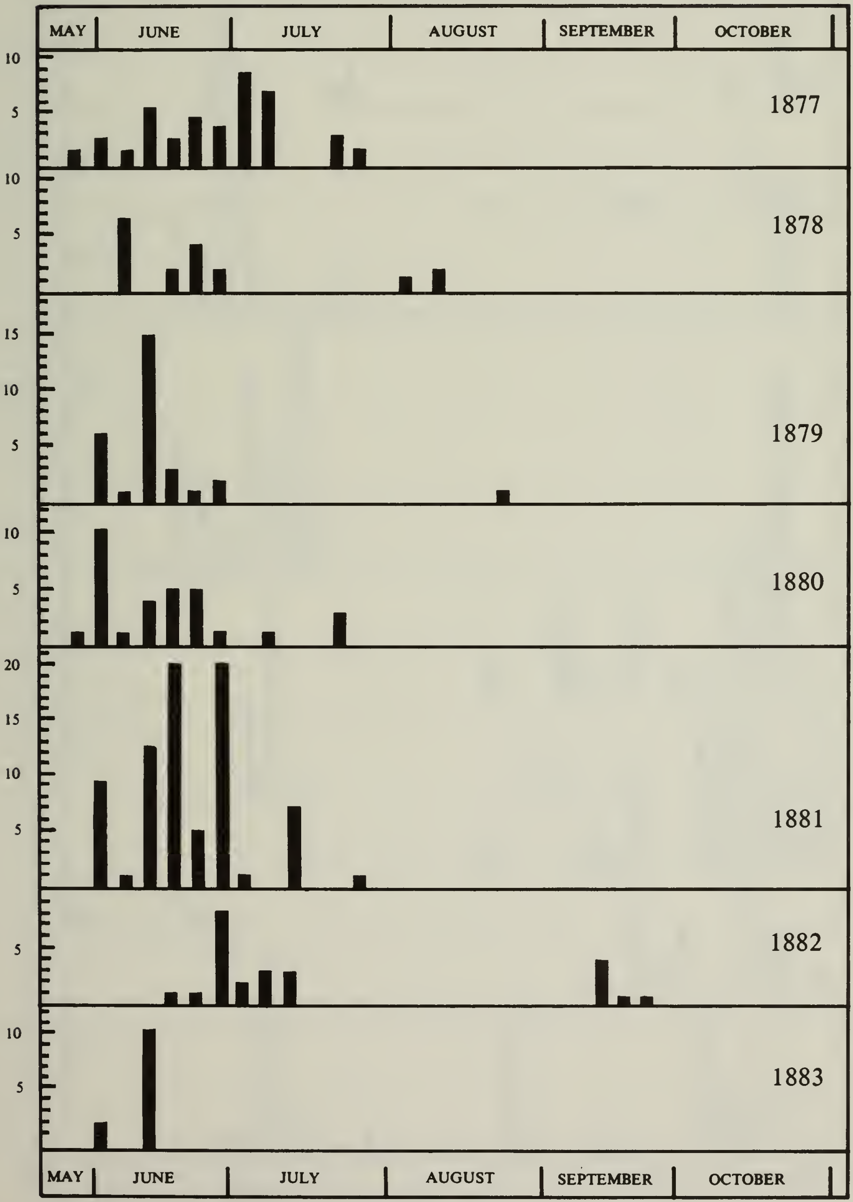
Year	No. Fry Released	No. Adults Counted at Essex Dam Fishway	Correction Factor for Pop. Est.	Est. No. Grilse	Est. No. 2-Sea-Yr. Fish	Est. No. 3-Sea-Yr. Fish	Correction Factor for No. Spawning Fish	Est. No. of Fish Reaching Spawning Grounds	Est. No. Fry Produced	No. Fish Captured at Livermore Falls
1867	15,000									
1868										
1869	5,000									
1870	1,000									
1871										
1872	16,000									
1873	174,000									
1874										
1875	245,000									
1876	400,000			20						
1877		47	1.5	11	346		0.8	286		
1878		17	1.0	24	48	10	0.8	66	92,000	11
1879		29	1.0	33	317	4	0.8	283	17,000	22
1880	143,000	30	1.0	28	571	12	0.4	239	84,000	21
1881	443,000	72	2.0	7	596	60	0.6	398	70,000	25

Year	No. Fry Released	No. Adults Counted at Essex Dam Fishway	Correction Factor for Pop. Est.	Est. No. Grilse	Est. No. 2-Sea-Yr. Fish	Est. No. 3-Sea-Yr. Fish	Correction Factor for No. Spawning Fish	Est. No. of Fish Reaching Spawning Grounds	Est. No. Fry Produced	No. Fish Captured at Livermore Falls
1882	455,000	24	1.0	1	113	52	0.4	66	119,000	33
1883	392,000	12	0.5	17	25	12	0.4	22	11,000	20
1884	600,000	17	1.0	41	286	3	0.5	165	52,000	17
1885	500,000	17	1.0	25	705	30	0.6	456	47,000	17
1886	600,000	14	0.5	79	435	74	0.6	353	140,000	15
1887	420,000	87	2.0	101	1,353	46	0.8	1,200	108,000	40
1888	600,000	74	2.0	50	1,735	142	0.8	1,542	371,000	30
1889	600,000	41	1.0	95	864	182	0.8	913	484,000	52
1890	240,000	47	1.5	77	1,629	90	0.8	1,437	276,000	60
1891	332,000	67	1.5	159	1,324	170	0.6	992	441,000	75
1892	200,000	84	2.0	191	2,732	139			293,000	
1893		97	2.0	28	3,286	286				
1894		11	0.5	97	488	344				
1895		52	1.5	49	1,676	51				
1896			1.0*	9	850	175				
1897			1.0*		152	89				
1898						16				
	6,381,000	839		1,118	19,531	1,987		8,418	2,605,000	438

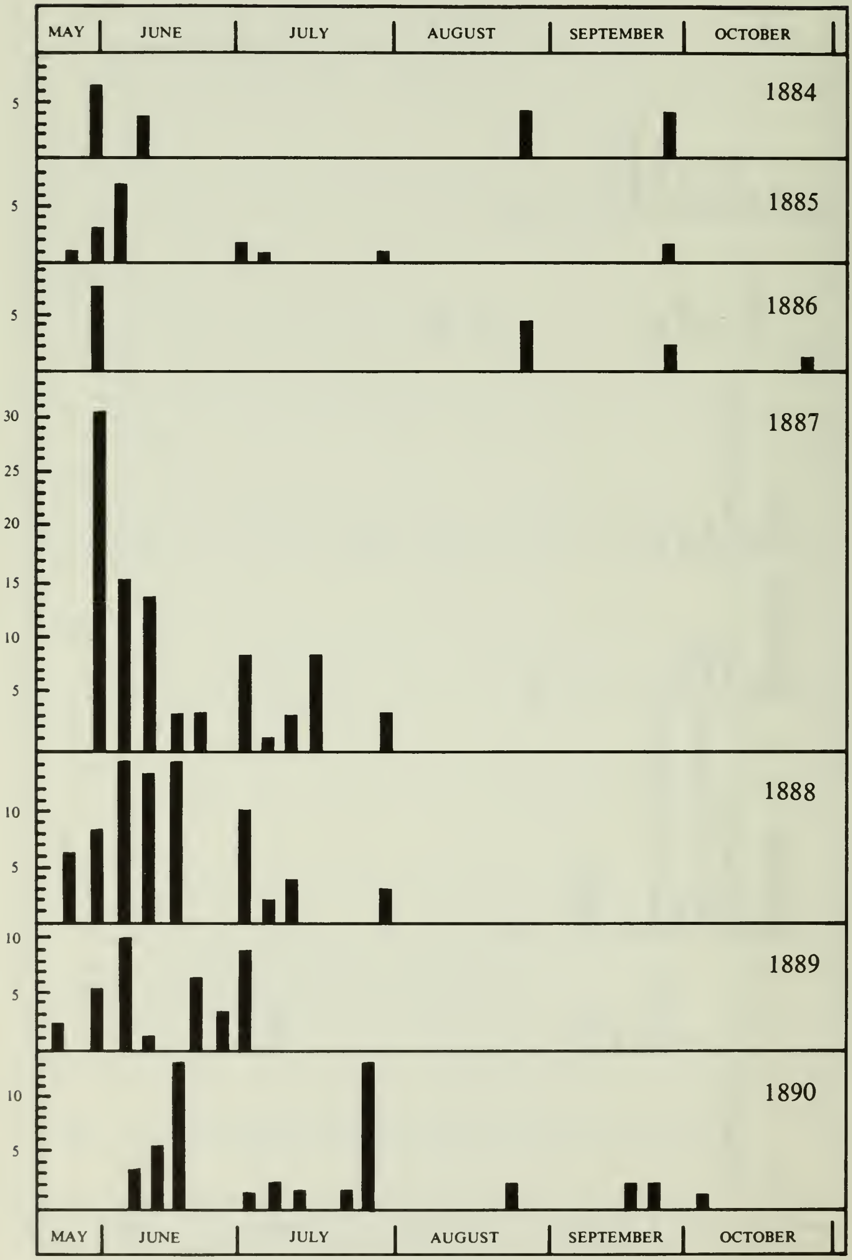
* No information was available in order to calculate a correction factor. Therefore, 1.0 was arbitrarily chosen.

Appendix V

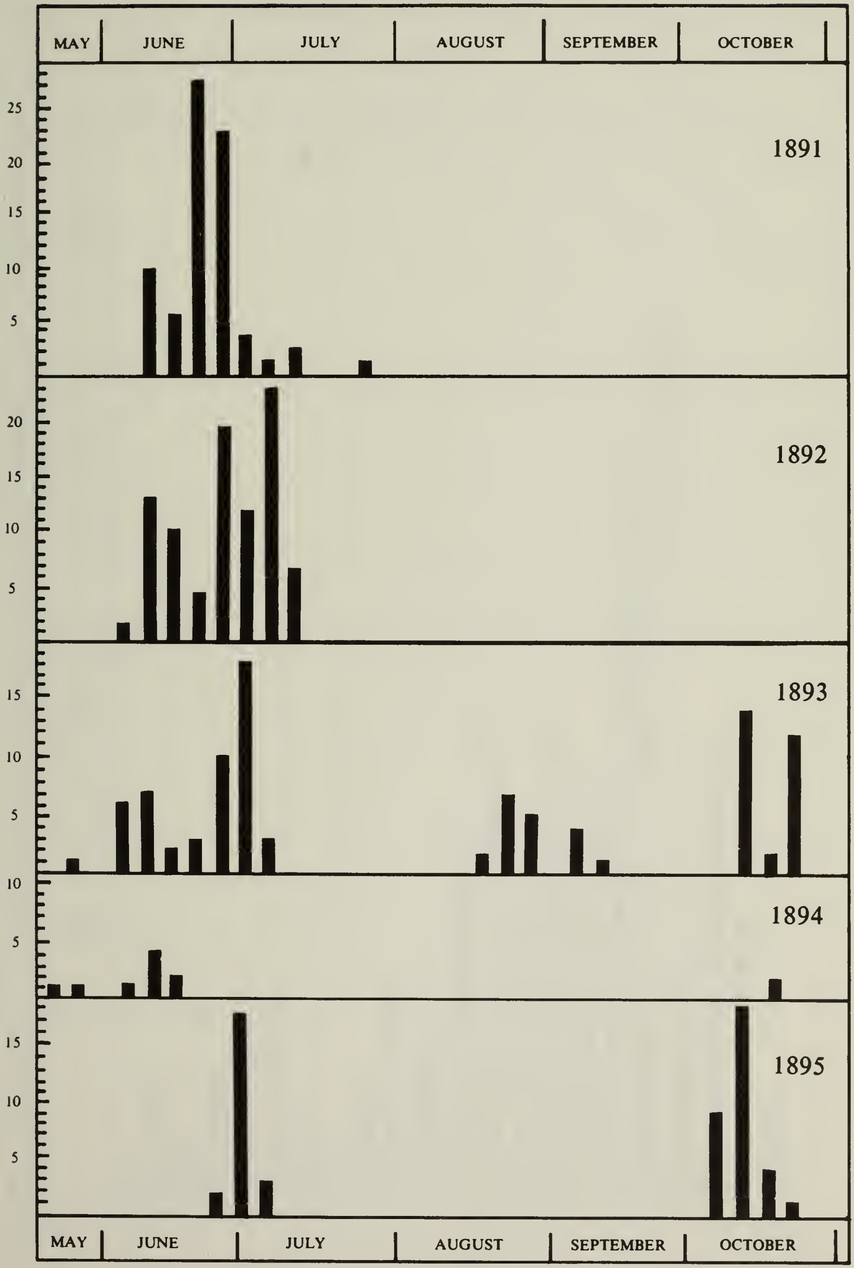
FISHWAY COUNTS AT THE LAWRENCE DAM ON A WEEKLY BASIS (1877 - 1895)



FISHWAY COUNTS AT THE LAWRENCE DAM ON A WEEKLY BASIS (1877 - 1895)

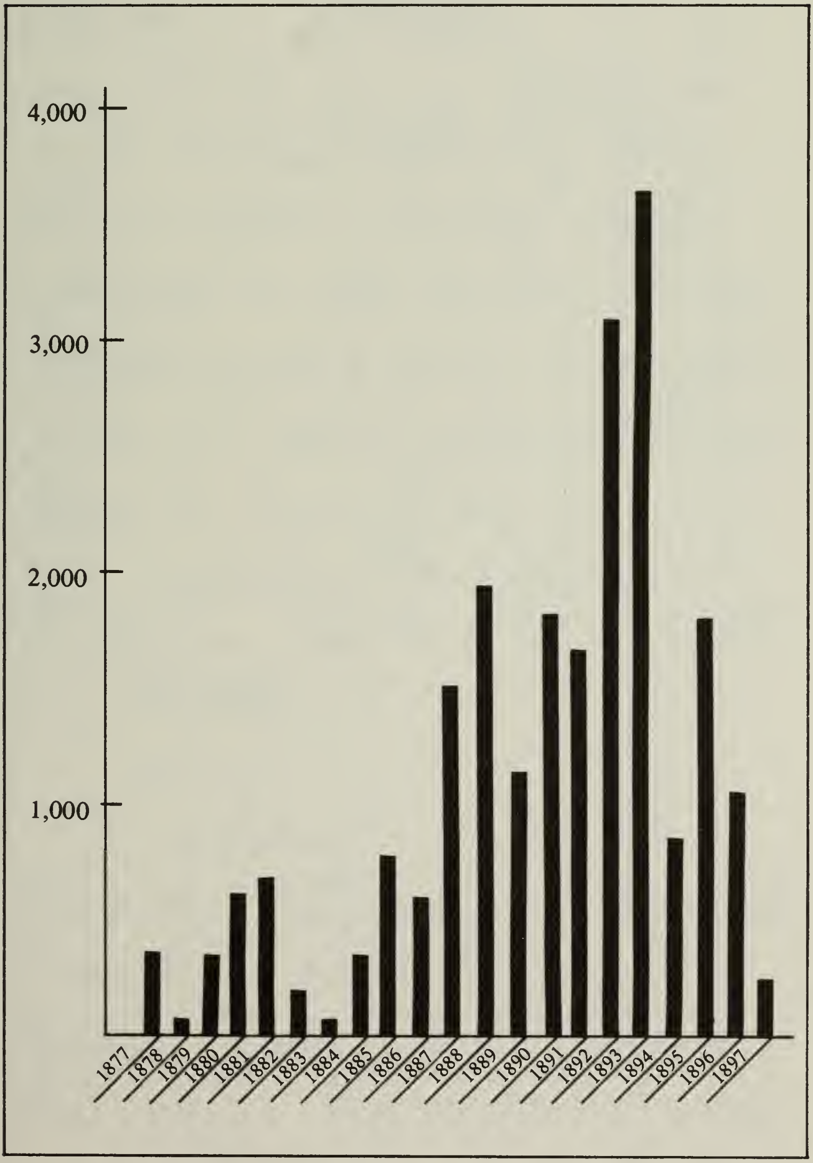


FISHWAY COUNTS AT THE LAWRENCE DAM ON A WEEKLY BASIS (1877 - 1895)



Appendix VI

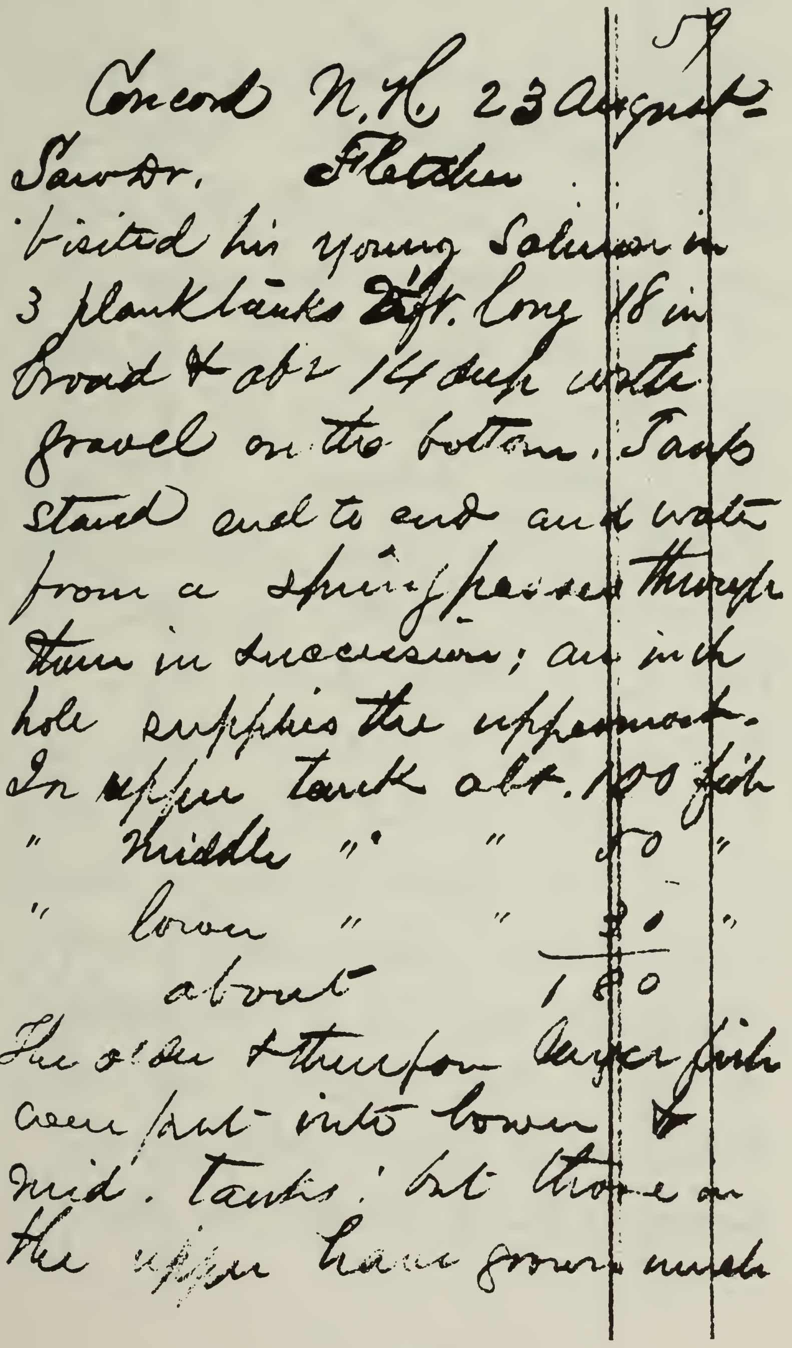
ESTIMATED NUMBER OF ATLANTIC SALMON THAT RETURNED TO THE MERRIMACK RIVER, 1877 THROUGH 1897



Appendix VII

EXCERPTS FROM THE DIARY OF CHARLES G. ATKINS

1867



57

Concord N.H. 23 August.
Saw Dr. Fletcher
visited his young Salmon in
3 plank tanks 2 ft. long 18 in
broad & ab't 14 deep with
gravel on the bottom. Tanks
stand end to end and water
from a spring passes through
them in succession; an inch
hole supplies the uppermost.
In upper tank ab't. 100 fish
" middle " " 50 "
" lower " " 30 "
about 180
The older & therefore larger fish
were put into lower &
mid. tanks; but those in
the upper have grown much

faster & are fast catching
up with the older. "I have
the first pick at the feed
in the water" Dr. says.
I should think the larger
are now hard on to 3 in
long - being between 7 & 8 mos
old. Are fed abt. daily,
generally with angle
worms. The tanks are
covered in & locked, having
2 in holes bored through cover
I noticed that a large part
had black tails distinctly
defined - say 1/3 of length of
body - Dr. says if they are
taken out and allowed to
stand in a dish in the

61

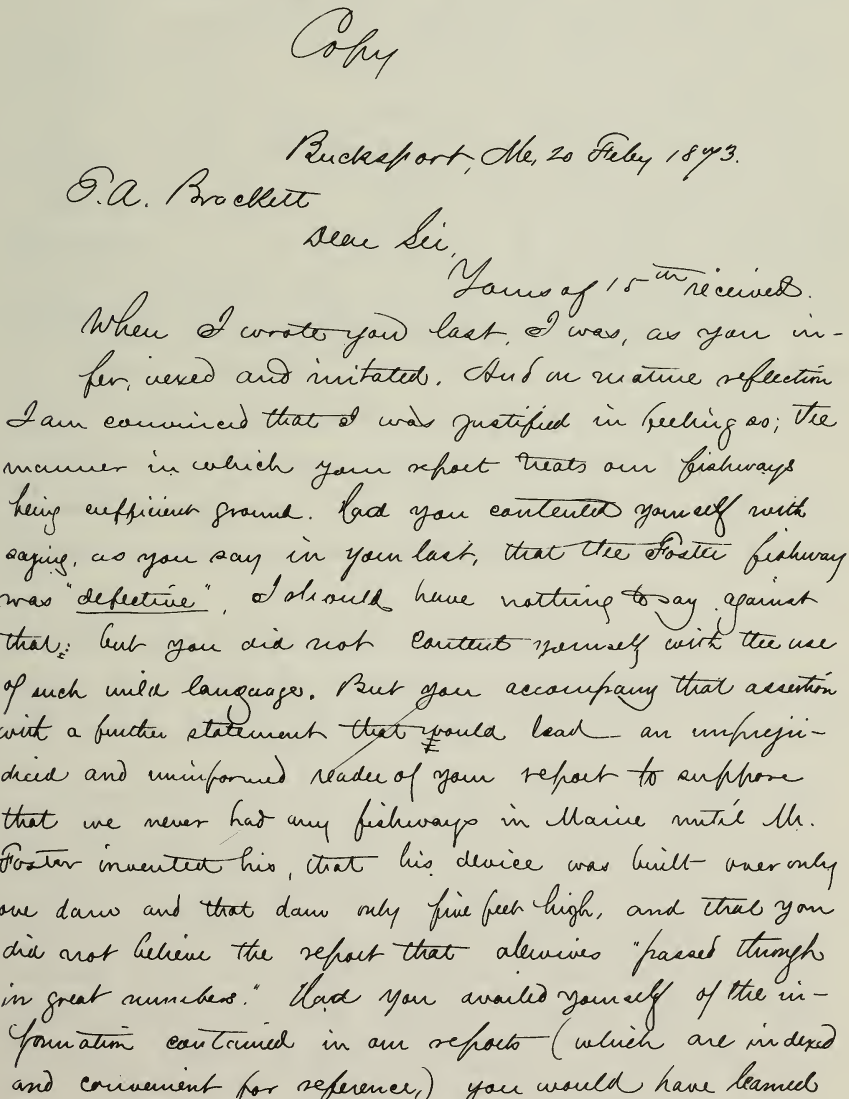
light a few minutes they
in that time fade out, again
to a uniform color. Thinks
the ~~black is cause~~ difference
in color is caused by their
lying with heads in the light
that comes down through the
holes & tails in the dark.

62

Dr. F. says that the Salmon
on Miramichi that were
cut open to obtain the spawn
were cut because it was
simply easier than to strip
them, which might have been
done.

Appendix VIII

A LETTER FROM CHARLES G. ATKINS TO E.A. BRACKETT, FISHERIES COMMISSIONER OF MASSACHUSETTS IN 1873



Copy

Bucksport, Me, 20 Feby 1873.

E.A. Brackett

Dear Sir,

Yours of 15th received.

When I wrote you last, I was, as you infer, vexed and irritated. And on mature reflection I am convinced that I was justified in feeling so; the manner in which your report treats our fishways being sufficient ground. Had you contented yourself with saying, as you say in your last, that the Foster fishway was "defective", I should have nothing to say against that; but you did not content yourself with the use of such mild language. But you accompany that assertion with a further statement that would lead an unprejudiced and uninformed reader of your report to suppose that we never had any fishways in Maine until Mr. Foster invented his, that his device was built over only one dam and that dam only five feet high, and that you did not believe the report that alewives "passed through in great numbers." Had you availed yourself of the information contained in our reports (which are indexed and convenient for reference,) you would have learned that "for many years before 1867 fishways had been successfully built on some of our own rivers",—which conflicts with your statement that there had been no successful ones except the Cape Cod fishway (which may be true for Massachusetts, but is not true for the whole country.") You might have learned, further, that the Foster fishways erected at Union Mills (on St. Croix) and Pembroke (on Pennamaquan) were tested in 1870, and, according to report of reliable persons, were successful — and that in my report for 1870, p. 22, I described the fishway at Warren (illustrated by Pl. II, figs. 5, 6 & 7,) and called particular attention to one feature in its construction which is essentially the same as your check at the end of the bulkheads, and suggested its removal to a point where it would correspond with the other check or breakwater in your fishway, these two checks, being, so far as I can see the only essentials in which your fishway differs from an ordinary square fishway ~~th~~ such as have been built for many years in our state.

Now I am not urging this matter upon your attention for the purpose of setting up claims of my own. I think those features in fishways belong to the public,—the first because it has been *long* in use at Warren, —the second because it was naturally suggested by the first and has been given to the public by a public officer, through the medium of his official report. Here I may as well correct an error in my previous letter on this subject. I said these two new features had both been in use in this state — that is not correct as regards the second, which has only been *planned*, so far as I know.

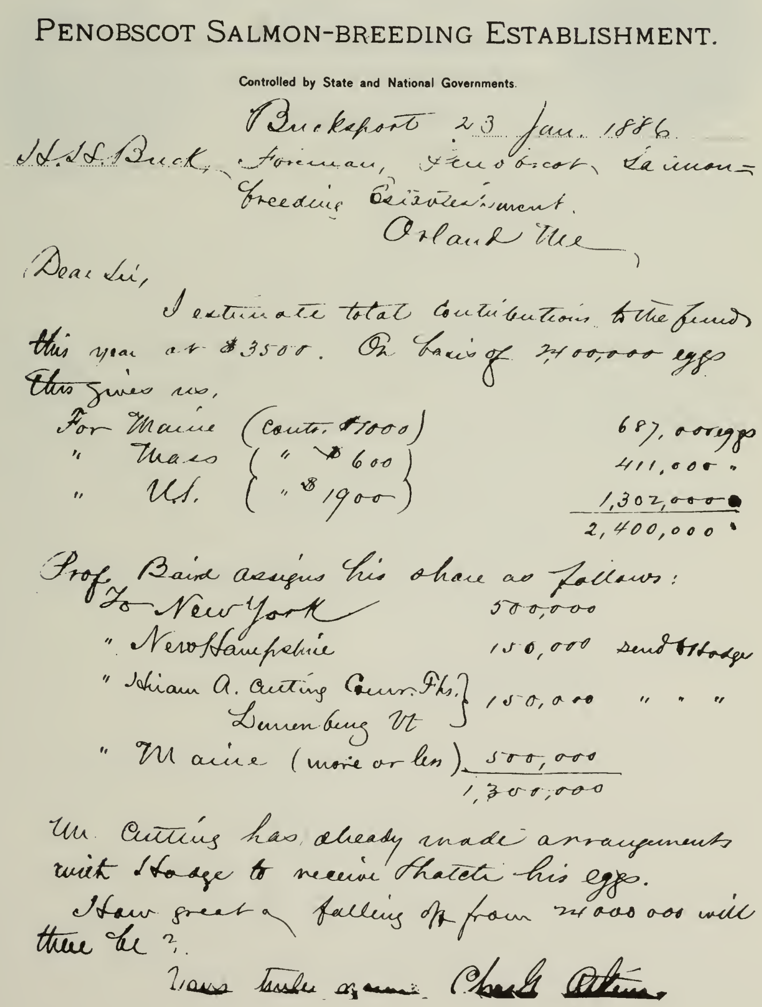
I freely grant that the Foster fishway was defective, and though I have never seen a fishway of yours in actual operation, I am quite ready to believe that where the amount of water it will deliver is large enough, it will work better than any Foster fishway, and that for alewives it is the best thing known. I think the Foster fishway often failed to do what was expected of it because details were not attended to in it. I believe Foster himself planned some very poor fishways and selected some very poor locations; but that Foster fishways can be built so as to do good service I am convinced. (See Mass. Rept. for 1870, p. 4.) In your plans you have elaborated the details, and to that cause I think you owe your success.

I suppose &c + + + (here follow 8 lines about salmon eggs, tow &c.)

Yours &c. Chas. G. Atkins.

Appendix IX

CORRESPONDENCE RELATIVE TO THE SHIPMENT OF SALMON EGGS FROM MAINE TO NEW HAMPSHIRE IN 1886



PENOBSCOT SALMON-BREEDING ESTABLISHMENT.

Controlled by State and National Governments.

Bucksport 23 Jan. 1886.

H. H. Buck, Foreman, Penobscot Salmon-
breeding Establishment.
Orland Me

Dear Sir,

I estimate total contributions to the fund this year at $3500. On basis of 2,400,000 eggs this gives us,

For Maine	(contr. $1000)	687,000 eggs
" Mass	(" $600)	411,000 "
" U.S.	(" $1900)	1,302,000 "
		2,400,000 "

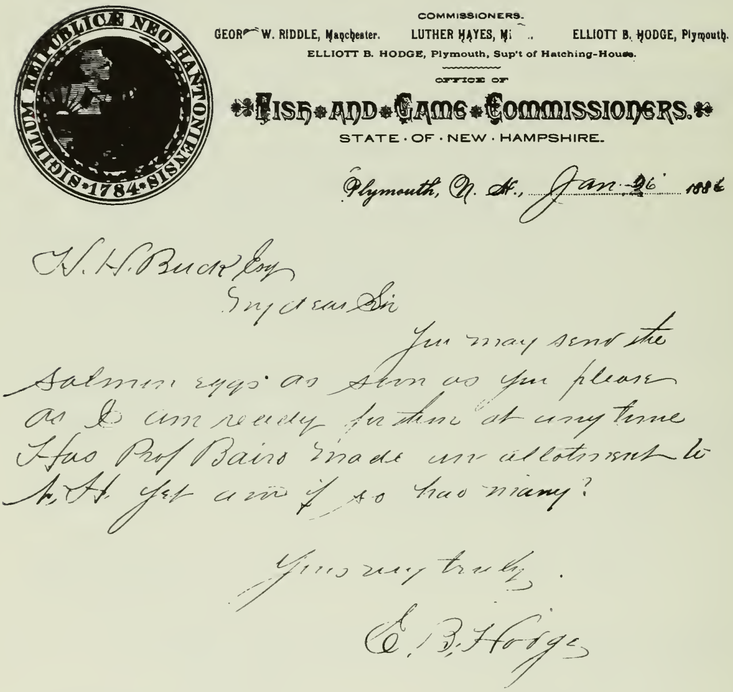
Prof. Baird assigns his share as follows:

To New York	500,000	
" New Hampshire	150,000	send to Hodge
" Hiram A. Cutting Comr. Fis. Lunenburg Vt	150,000	" " "
" Maine (more or less)	500,000	
	1,300,000	

Mr. Cutting has already made arrangements with Hodge to receive & hatch his eggs.

How great a falling off from 2400000 will there be?

Yours truly &c. Chas G. Atkins



COMMISSIONERS.
GEOR W. RIDDLE, Manchester. LUTHER HAYES, Mi . ELLIOTT B. HODGE, Plymouth.
ELLIOTT B. HODGE, Plymouth, Sup't of Hatching-House.

OFFICE OF
FISH AND GAME COMMISSIONERS.
STATE · OF · NEW · HAMPSHIRE.

1784

Plymouth, N. H., Jan. 26 1886

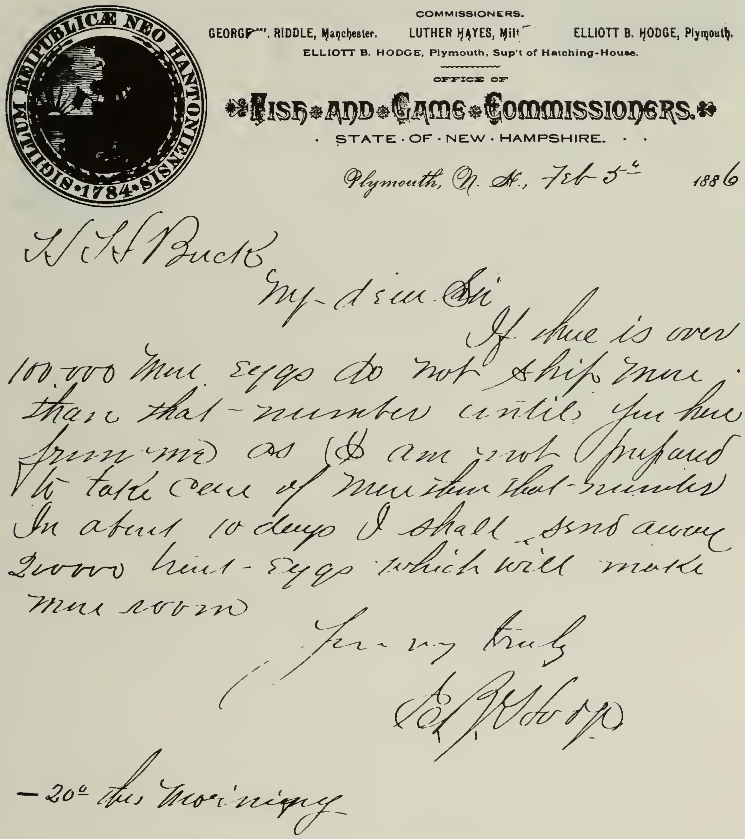
H. H. Buck Esq

My dear Sir

You may send the Salmon eggs as soon as you please as I am ready for them at any time. Has Prof Baird made an allotment to N. H. yet and if so how many?

Yours very truly.

E. B. Hodge



COMMISSIONERS.
GEORG . RIDDLE, Manchester. LUTHER HAYES, Mil ELLIOTT B. HODGE, Plymouth.
ELLIOTT B. HODGE, Plymouth, Sup't of Hatching-House.

OFFICE OF
FISH AND GAME COMMISSIONERS.
STATE OF NEW HAMPSHIRE.

Plymouth, N. H., Feb 5th 1886

W. H. Buck

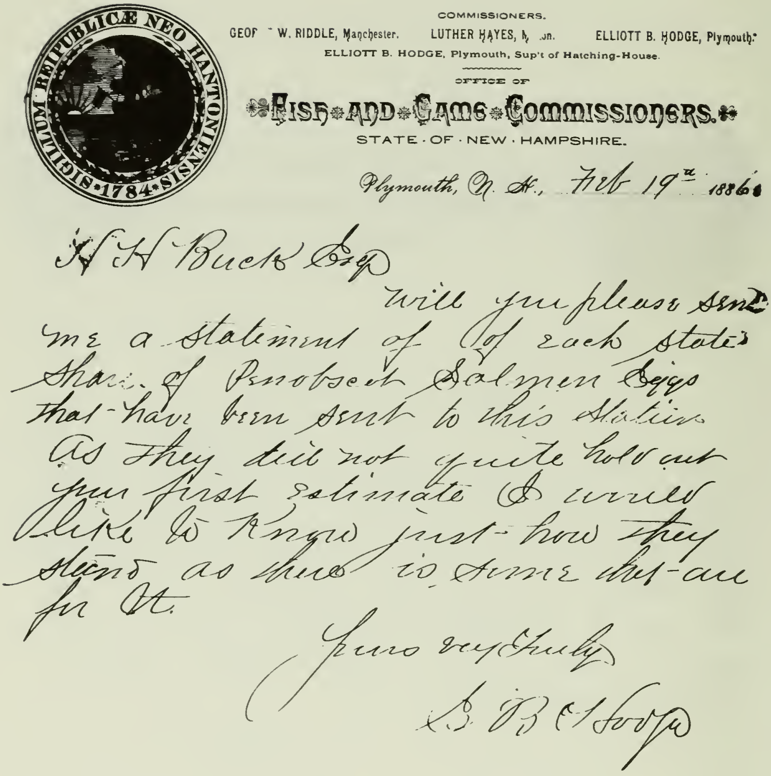
My dear Sir

If there is over 100.000 more eggs do not ship more than that number until you hear from me as I am not prepared to take care of more than that number In about 10 days I shall send away 20000 trout eggs which will make more room

Yours very truly

E. B. Hodge

— 20° this morning



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ELLIOTT B. HODGE, Plymouth, Sup't of Hatching-House.
OFFICE OF
FISH AND GAME COMMISSIONERS.
STATE · OF · NEW · HAMPSHIRE.

1784

Plymouth, N. H., Feb 19th 1886

H H Buck Esq

Will you please send me a statement of of each state's share of Penobscot Salmon Eggs that have been sent to this Station As they did not quite hold out your first estimate I would like to know just how they stand as there is some that are for Vt.

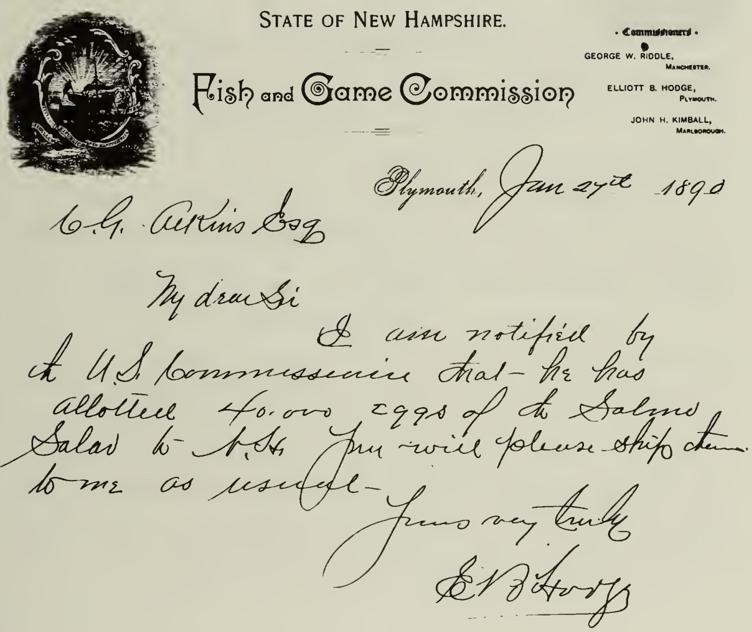
Yours very Truly

E. B. Hodge

A great deal of correspondence occurred regarding the shipment of eggs from Maine to New Hampshire in 1886. The eventual release of 600,000 fry, was derived from the 50,000 eggs taken during the fall of 1885 from Merrimack River salmon, the 411,000 eggs allotted to Massachusetts from Bucksport, and the 150,000 eggs allotted to New Hampshire from the same establishment.

Appendix X

CORRESPONDENCE RELATIVE TO THE SHIPMENT OF SALMON EGGS FROM MAINE TO NEW HAMPSHIRE IN 1890



STATE OF NEW HAMPSHIRE.

Fish and Game Commission

· Commissioners ·
GEORGE W. RIDDLE, Manchester.
ELLIOTT B. HODGE, Plymouth.
JOHN H. KIMBALL, Marlborough.

Plymouth, Jan 27th 1890

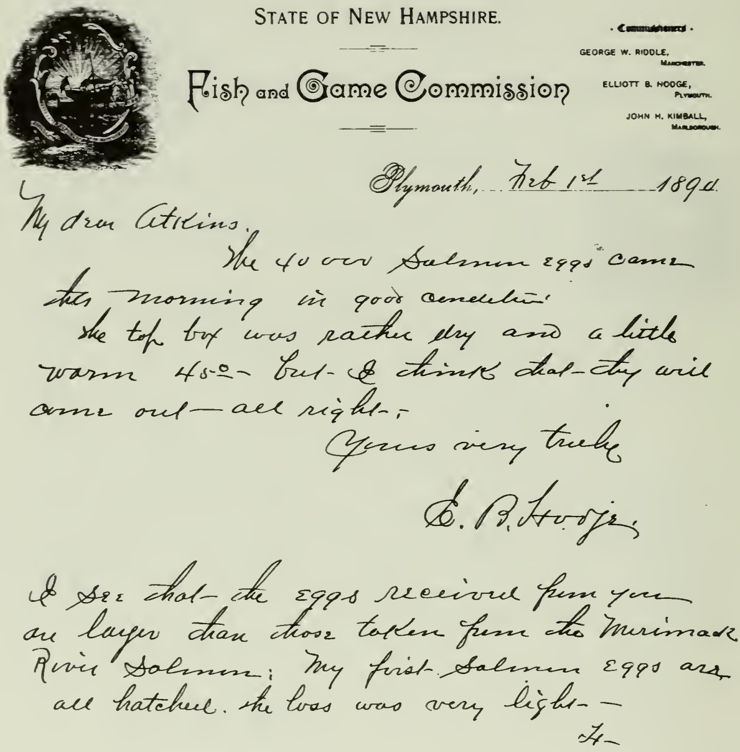
C. G. Atkins Esq

My dear Sir

I am notified by the U.S. Commissioner that he has allotted 40.000 eggs of the Salmo Salar to N.H. You will please ship them to me as usual—

Yours very truly

E. B. Hodge



STATE OF NEW HAMPSHIRE.
Fish and Game Commission

· Commissioners ·
GEORGE W. RIDDLE,
Manchester.
ELLIOTT B. HODGE,
Plymouth.
JOHN H. KIMBALL,
Marlborough.

Plymouth, Feb 1st 1894.

My dear Atkins,

The 40 000 Salmon eggs came this morning in good condition
the top box was rather dry and a little warm 45° but I think that they will come out all right;

Yours very truly

E. B. Hodge.

I see that the eggs received from you are larger than those taken from the Merrimack River Salmon; My first Salmon eggs are all hatched. the loss was very light—

H—

PENOBSCOT SALMON EGGS

SHIPMENT.

Shipped on the 30th day of Jany. 1890, a lot of Penobscot Salmon eggs, numbering 40,000 in 1 case, addressed to E. B. Hodge

Plymouth New Hampshire

Chas. G. Atkins.

East Orland, Me., 30 Jany 1890

☞ Please to fill out, sign and return, without delay, the following

ACKNOWLEDGEMENT OF RECEIPT.

Above package received at Plymouth New Hampshire on the first day of Febuary 1890 at 11 o'clock a.M., and unpacked at 11 o'clock A M., on the first day of Febuary

General condition of package, and of eggs, good -

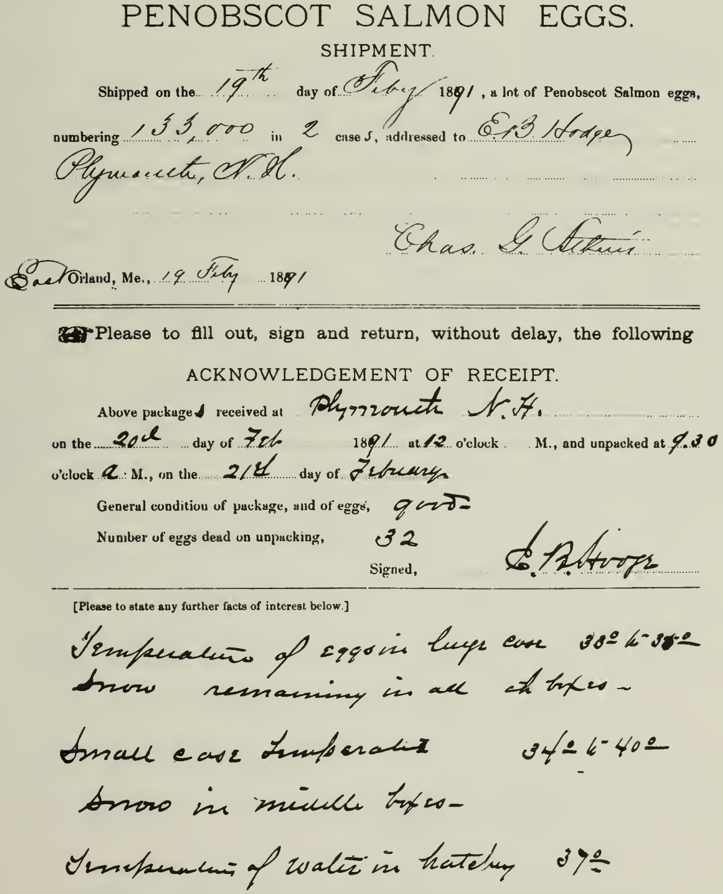
Number of eggs dead on unpacking, 5-6.

Signed, E. B. Hodge

[Please to state any further facts of interest below.]

Appendix XI

THE RECORD OF ATLANTIC SALMON EGGS SHIPPED FROM MAINE TO NEW HAMPSHIRE IN 1891



PENOBSCOT SALMON EGGS.

SHIPMENT.

Shipped on the 19th day of Feby 1891, a lot of Penobscot Salmon eggs, numbering 133,000 in 2 cases, addressed to E. B. Hodge
Plymouth, N.H.

Chas. G. Atkins

East Orland, Me., 19 Feby 1891

☞Please to fill out, sign and return, without delay, the following

ACKNOWLEDGEMENT OF RECEIPT.

Above packages received at Plymouth N.H.
on the 20d day of Feb 1891 at 12 o'clock M., and unpacked at 9.30 o'clock a. M., on the 21st day of February.

General condition of package, and of eggs, good.

Number of eggs dead on unpacking, 32

Signed, E. B. Hodge

[Please to state any further facts of interest below.]

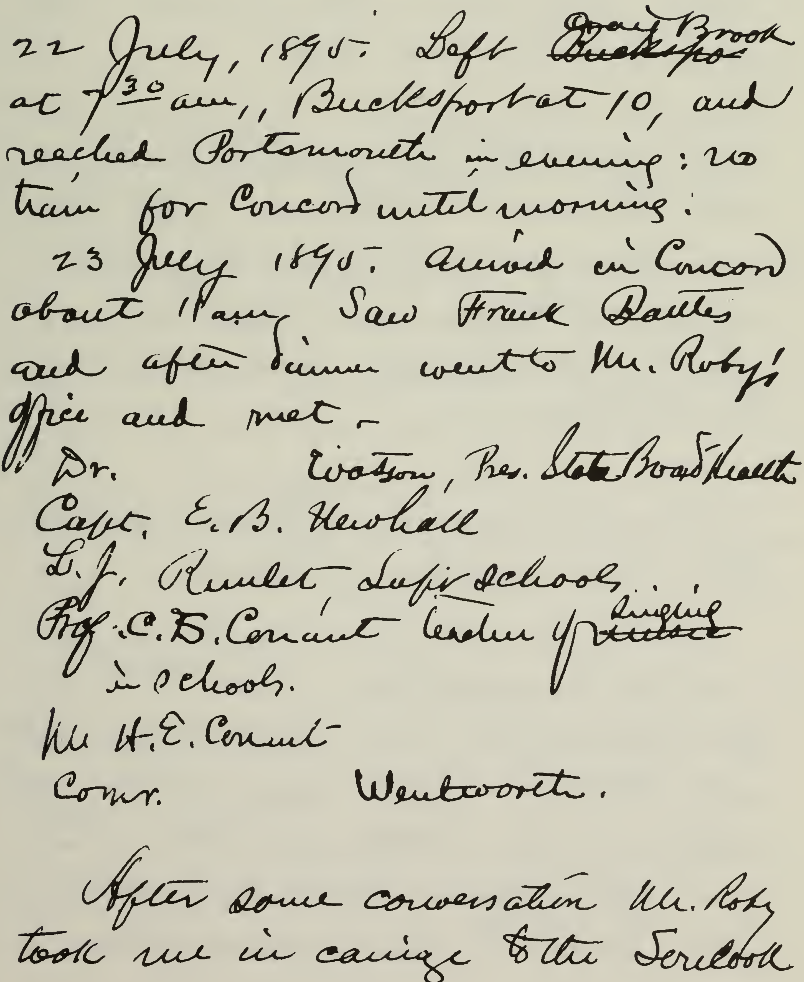
Temperature of eggs in large case 38° to 38°
Snow remaining in all the boxes –

Small case temperature 34° to 40°
Snow in middle boxes –

Temperature of water in hatchery 37°

Appendix XII

EXCERPTS FROM THE DIARY OF CHARLES G. ATKINS - 1895



22 July, 1895. Left ~~Bucksport~~ Craig Brook at 7$^{\underline{30}}$ am., Bucksport at 10, and reached Portsmouth in evening: no train for Concord until morning.

23 July 1895. Arrived in Concord about 11 a.m. Saw Frank Battles and after dinner went to Mr. Roby's office and met –

Dr. Watson, Pres. State Board Health
Capt. E. B. Newhall
L. J. Rundlet, Supt Schools
Prof. C. B. Conant leader of ~~music~~ singing
in schools.
Mr H. E. Conant
Comr. Wentworth.

After some conversation Mr. Roby took me in carriage to the Seabrook

river which we struck at 3 places
— 1st at Clough's Mills: 2nd, at a
bridge below; — 3d at its mouth.
At Clough's Mills I took several
photographs and examined the old
dam, mill &c. — all in ruins. This
property is now owned by

and occupied by another party.
At the mouth of the river, Mr. Roby
showed me where he saw so
many salmon in Aug 1893.
They lay all the way from mouth up
to R-R bridge.

In evening received Frank Battles,
Mr. Roby & Rev. J. F. Hill.

Wednesday 24 July. Took 6^{30} train
for Plymouth, Visited hatchery, talked
with McLinn, took some photographs
and returned to Concord at 12^{40}
After supper drove out with
Mr. Battles to Richardson's Mills on

23 July 95 – Dunpson Brk – above Clough Dam – not more than 2 gls per min. Next brook above abt same probably – "Gore Brook," 1 mile above. Several others above that, – good trout brooks.

the Soucook, examined dam & stream & returned.

25 July 95. Went up to Sewalls falls and examined fishway and dam, taking 6 views.

Fishway very steep, placed entirely on top of dam, height above same, 3 ft. outside, 2 ft 4 in. to top of bulkheads: abt. 10 ft. wide, divided into compartments after Brackett plan. Water today flows in abt. 9½ in deep, but wastes away so that at lower end it is not over 2 in deep on deepest side & shoots out in a very thin sheet on other side. Absolutely impossible for salmon to get up. Not probable that they would pass up in any stage of water, it is so steep. It is not protected by anything at upper end and is not covered over.

Tried temperature at head & foot of fishway and on bar below, & found it everywhere 77° by the little thermometer bought of Eastman. The dam itself is evidently impassable.

25 July p.m. Interviewed Mr. Battles at his shop and met there Mr. John P. George & } both lawyers
Fred. H. Gould } & sportsmen.
Mr. Gould is posted in Sunapee.

26 July, 1895. At Battles shop met Dr. Kimball —

Went down to Suncook Lower bridge, waded up from the R.R. bridge to a point-about 2 miles up, near the ~~Suncook or~~ road called "Pembroke Street." I saw a good many places where I have no doubt salmon have spawned in the past — the conformation of the bottom is as they left it. There are no deep pools below the first highway: above that there are several, that look 5 ft.

deep before you get to the first bluff. Here, the trend is eastward and no pools for a long distance. At the point where I left the river

there is a very deep pool to be be seen just above, and it looks as if there were several above that. Bottom rises very slowly to the first highway, or above that to the sharp bend at the high bluff. From there the rise must be very considerable, as the rapids are continuous. I am afraid there will not be 6 ft. fall to first highway.

I saw some shiners and chubs and Pomotis, but no salmon, large or small.

27 July '95. Returned to Boston & in evening sailed on Str Lewiston for Bucksport.

5 Aug. 1895. Arrived in Boston on way to New Hampshire, via Str. Lewiston at 7 a.m.

In a.m. went out to Winchester & had a talk with E.A. Brackett.

In p.m. went to Concord, N.H.

In evening saw Battles, Roby & Berry, the engineer who has been engaged to survey the lower Contoocook.

6 Aug 95: Went with Berry & assistants to lower Contoocook.

Temperature obs. in Contoocook R: 6 aug

Hour. a.m.	Place	Temp degs
9	1st bend below lower bridge	68
10^{30}	same place	70
1^{30}	" "	75
3^{30}	" "	76

A very hot day. I suppose this represents near the maximum.

I exposed 8 plates.

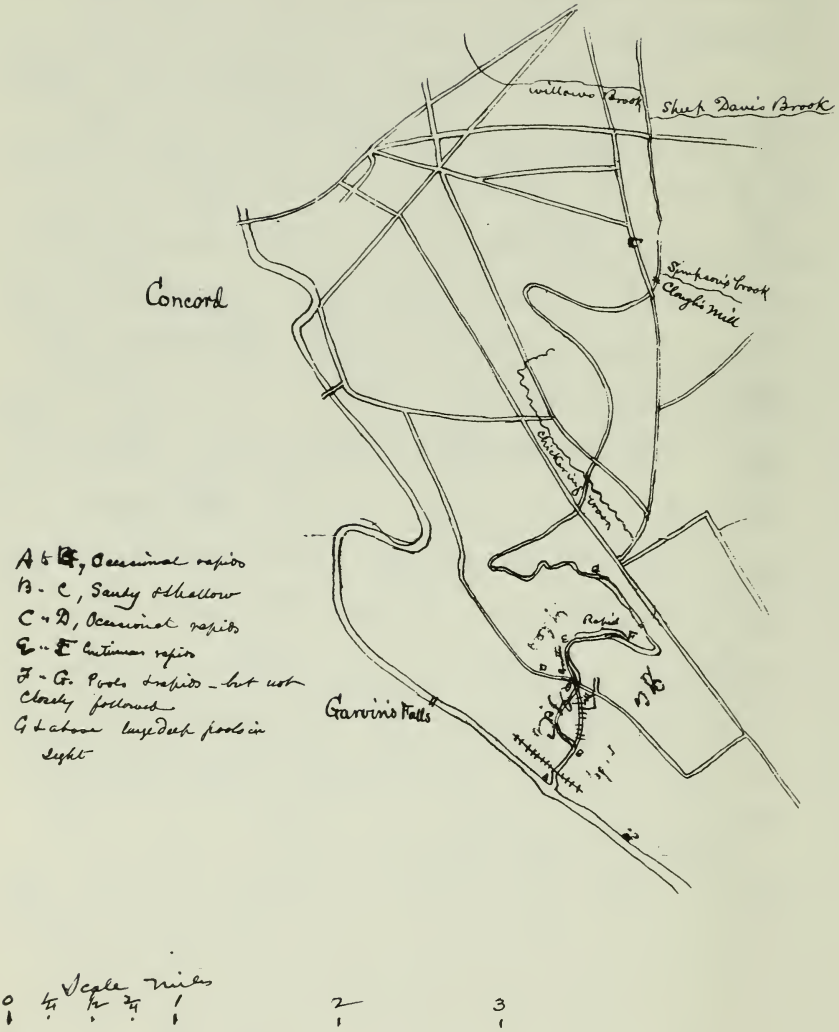
Engineer has run a line alongside the stream from highway down nearly to Mouth.

Aug. 7, 1895. This morning Mr. Berry resumed work and ran a line of levels down from lower highway bridge to ~~near~~ the mouth. From hy. bridge to lower side of R.R.

bridge was 6. ft.– but rain
coming on he was not able to
[illegible] run back and check his
work.

I made copy of plan in office
of Mr. Berry and called on
Chas. L. Fellows, an officer of
Garvin's Falls Co. who said he
should have to refer question of
lease and sale to the President of
the Company, Mr. Russel
of ~~New York~~, who is in Boston
every Saturday and Monday &
in New York the rest of the time.
Called also on Nath. Martin, Esq.,
who owns 10 acres on SE side of Soucook
Flow road: he will lease for 10 yrs. for
a nominal rate and will consider
the question of sale.

In p.m. drove down to Garvin's Falls
and took views of the dam. Temperature
of river just below G. falls dam, at
5 pm was 73°: day has been cloudy.
for the most part.


Willows Brook
Sheep Davis Brook
Simpson's brook
Clough's Mill
Concord
Chickering Brook
Rapids
Garvin's Falls
A to B, Occasional rapids
B – C, Sandy & shallow
C to D, Occasional rapids
E – F Continuous rapids
F – G. Pools & rapids – but not closely followed
G & above large deep pools in sight
Scale miles
0
1/4
1/2
3/4
1
2
3

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